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RAT-BITE FEVER IN THE PHILIPPINES

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THREE PLATES

The existence of rat-bite fever (sodoku) in the Philippines has evidently been suspected by a few practicing physicians. Consultation of the literature reveals a clinical case reported by Dr. Manuel Guerrero [1] and another clinical case is reported by José Montes.[2] As far as their reports show, their observations were purely clinical; they did not demonstrate or identify in the suspected cases the presence of the spirochæte that causes the disease.

The object of the present communication is to report a case of rat-bite fever in a native child in Manila in which the causative agent of the disease, *Spirochæta morsus muris,* was demonstrated and identified.

HISTORY OF THE ILLNESS

On January 20, 1931, about 9 a. m., a little girl, 4 years old, named Iluminada Flores, residing at 350 Sevilla, San Nicolas, was brought to the Bureau of Science for Pasteur treatment, after having been bitten by a rat. The patient presented a very conspicuous œdematous swelling of the forehead, the sides of the face, and the neck. The sides of the face were overlaid by distinctly visible maplike red macules. A vivid recollection of

[1] Rev. Filip. de Med. y Farmacia (July, 1917).
[2] Rev. Filip. de Med. y Farmacia 14 (1923) 304.

a graphic description of a case of rat-bite fever in Spain, reported by Pascual Escolano,[3] enabled me to diagnose this case at first sight as rat-bite fever. Lt. Col. Hayashi Hirano, Medical Corps, Imperial Japanese Army, at present in the Bureau of Science, was consulted and gave me very useful suggestions on how to proceed in isolating the causative spirochæte.

The patient was bitten on the forehead by a rat on January 5, 1931, late at night, while in bed. The bite healed quite uneventfully within the next few days. One week after she had been bitten, she developed fever at 6 p. m., which lasted the whole night up to 10 a. m. the following day. She was then free from fever for two days. Fever again appeared at 6 p. m. and lasted three hours. This time the skin around the healed bite, covering an area about the size of a peso coin, was swollen and red. The patient was free from fever for two days. She again developed fever lasting from 6 p. m. to 8 p. m. On January 19, 1931, at 6 p. m., the patient developed fever which lasted two hours. In the meantime the swelling and red spots had gradually extended to include the forehead, the sides of the face, and the sides of the neck, but the patient evidenced no particular discomfort, and continued to play and eat quite as usual.

On January 20, 1931, about 9 a. m., the patient presented the following symptoms:

1. An extensive diffuse, rather firm, œdema of the forehead and the sides of the face and neck; more extensive on the left side of the neck than on the right side.

2. An elongated, irregular, maplike red macule with elevated edges on each side of the face between the ears, posteriorly, and the cheeks, anteriorly, and extending from the level of the eyes above to near the edge of the lower jaw below.

3. A dusky, purplish, discolorization of the forehead was not very conspicuous on account of the brown complexion of the patient and the adhering remains of the ointments applied.

4. A reddish discolorization of the sides of the neck extending from the ears and the angle of the jaw to a little above the clavicle, on the left side, and only half-way this distance on the right side. Purplish blotches here and there on the left side of the neck.

5. A tiny white scar at site of bite, measuring 0.5 centimeter vertically and 0.3 centimeter horizontally, visible on close in-

[3] Rev. Med. y Cir. (1919).

spection, at a point situated at the junction of upper and middle third of the forehead, somewhat to the left of the median line.

6. A marked swelling of the anterior auricular and superior cervical lymphatic glands. A swelling of the supraclavicular lymphatic glands on the left side was also present.

7. All the swollen parts of the face felt warm to the touch, but the patient had no fever at that time.

8. The tongue was clean and the throat and tonsils normal.

9. The heart, the lungs, and the nervous system were normal.

January 21, 1931, 2.30 p. m.—The œdema and swelling of the glands still persist. The macules are now dusky red. An injection of sodium cacodylate combined with strychnine and sodium glycerophosphate was given the patient.

January 22, 1931.—The patient's mother reports that the patient had fever from 8 p. m. yesterday to 5 a. m. this morning. The tongue appears coated and œdema persists. The edges of the erythematous areas on the face and forehead are more elevated and are redder than the rest of the areas. The redness on the neck is less conspicuous now, and the glands are larger and softer. Injection of cacodylate, etc., was given.

January 23, 1931, 2.15 p. m.—The œdema has somewhat subsided. The macules are paler red than before. The glands have reduced in size. Cacodylate, etc., were again injected.

January 24, 1931, 9 a. m.—The œdema has further subsided. The macules are paler and the glands smaller. A blood count was made and the hæmoglobin determined.

January 26, 1931, 2.30 p. m.—The patient is reported to have had fever from 8 p. m. January 24 to 5 a. m. January 25 and now appears quite pale. The macules have a light dusky reddish discolorization, and only the edges of the macules on both sides of the face show a marked red color. The œdema has greatly subsided; there is no redness on the neck. The tongue is still coated. Injection of cacodylate, etc., was given.

January 27, 1931, 2.30 p. m.—The macules have practically disappeared; only a little light red line on both sides of the face laterally to the malar region is still distinctly visible. The tongue is clearing up and the œdema has further subsided. The glands are smaller, but quite palpable. The patient is pale. Cacodylate, etc., were injected.

January 28, 1931, 2.30 p. m.—The patient is still pale, but the tongue is now clean. The little red lines on the face are still conspicuous. The œdema is less though the glands are still palpable. Cacodylate, etc., were given.

January 30, 1931, 2.30 p. m.—The patient's face presents a conspicuous appearance; a red, elevated line can be distinctly traced from a point at the level of the lower margin of the mandible, about one inch distant from the lobe of the ear, upward across the face to the right lower eyelid extending across the bridge of the nose, and following as an exactly symmetric line on the opposite side of the face to the lower margin of the left mandible. This line delimits symmetrical portions of the face, like a mask, the portions above the line being a pale dusky red, quite distinct from the portions of the face situated below the line. The œdema is

practically gone, the glands are smaller, and the tongue is clean; cacodylate, etc., were injected.

January 31, 1931, 9.45 a. m.—The above described line on the face of the patient is still visible, but no longer elevated. The œdema is not noticeable. The glands are still palpable. Cacodylate etc., were injected.

February 2, 1931, 2.30 p. m.—The line on the face is still visible, though not elevated, and on both sides of the face laterally to this line and about 0.75 inch distant from it, there is another red line, the intervening skin between the two lines being pale. The mask appearance is still distinctly visible. The glands are much smaller but still palpable.

February 3, 1931, 8 a. m.—The masklike effect is still present. The glands are smaller.

February 4, 1931, 9 a. m.—The red line described above as delimiting symmetrical portions of the face, has rounded up to include the lower part of the chin. The unaffected portions of the face are now the lower half of the nose, the inner half of the cheeks, and the tip of the chin. This picture is quite similar to that of Escolano's case. On the affected portions of the cheeks alternating red and pale areas of skin are seen, the red lines describing irregular turns inclosing in some places fanciful, flowerlike patches of pale skin. The glands, especially the upper cervical, are still palpable. Cacodylate, etc., were given. Wassermann reaction ++, and Kahn reaction ++++.[4]

February 5, 1931.—The masklike effect is still present, though the redness is less. The red line has bridged over from under the mandible to the left angle of the mouth. The glands are still palpable. Cacodylate, etc., were injected.

February 6, 1931.—The red line has bridged over from under the mandible to the right angle of the mouth; the redness is less. The anterior auricular glands are not palpable now, but the superior cervical glands are still palpable. Cacodylate, etc., were injected.

February 7, 1931.—The redness has greatly faded in all the masklike area. Cacodylate, etc., were injected.

February 9, 1931.—The masklike area is hardly visible. The redness has disappeared; instead, a brownish discolorization now occupies the previously reddish portions of the masklike area. The superior cervical glands are much smaller. Cacodylate, etc., were injected.

February 10, 1931.—A few reddish lines on the cheeks and on the sides of the chin are now seen. The superior cervical glands are still palpable. Cacodylate, etc., were injected.

February 11, 1931.—Reddish blotches are now present on the left temporal region. The superior cervical glands are still palpable. Ten centigrams of myosalvarsan (iso) was administered intramuscularly.

February 12, 1931.—No more reddish blotches anywhere. The patient had fever last night from 7 to 12 p. m. The superior cervical glands are smaller.

February 13, 1931.—The patient looks well. The glands are smaller.

February 16, 1931.—The patient looks well. The glands are still palpable, though greatly reduced.

[4] The serologic reactions were kindly performed by Dr. O. Garcia and read jointly by him and the author.

JANUARY 24, 1931

Hæmoglobin, per cent (Tallquist-Newcomer)[5]	57
Red cells per cubic millimeter	4,750,000
White cells per cubic millimeter	7,100
Differential count:	
Neutrophiles, per cent	60.5
Small lymphocytes, per cent	32.0
Large lymphocytes, per cent	2.0
Mononuclears, per cent	1.5
Eosinophiles, per cent	4.0
	100.0

FEBRUARY 6, 1931

Hæmoglobin, per cent (Tallquist)	50
Red cells, per cubic millimeter	4,370,000
White cells, per cubic millimeter	11,500
Differential count:	
Neutrophiles, per cent	68
Small lymphocytes, per cent	25
Large lymphocytes, per cent	2
Mononuclears, per cent	4
Eosinophiles, per cent	1
	100

February 6, 1931.—Reaction acid; glucose negative, albumin traces. Sediments: Abundant epithelial cells, leukocytes and amorphous urates, few mucous threads and cylindroids. No casts found.[6]

PROCEDURE EMPLOYED TO DEMONSTRATE THE CAUSATIVE AGENT OF RAT-BITE FEVER

A few drops of blood were obtained from the patient's forehead at points near the site of the bite and inoculated intraperitoneally into a white mouse (RB–Ms–1), and subcutaneously into the abdomen of a guinea pig (RB–M–1). Some gland juice was obtained from one of the superior cervical lymphatic glands (left side) and injected subcutaneously into the abdomen of a white mouse (RB–Ms–2).

Smears from tissue scrapings, obtained by scraping two incisions made near the site of the bite, were also prepared January 20, 1931. The smears were stained by Giemsa's method. The spirochæte was demonstrated in them.

[5] Erythrocyte and leukocyte counts and hæmoglobin percentage determinations were kindly made by Dr. José Ramirez.

[6] Routine examination of the patient's urine was performed by Dr. G. Sepulveda, Jr.

The blood of the mice and guinea pig was examined daily by dark-field illumination. Mouse RB–Ms–2 showed spirochætes in its blood for the first time after inoculation January 30, 1931; that is, ten days after its inoculation. Mouse RB–Ms–1 became positive February 5, 1931; that is, sixteen days after it was inoculated. The spirochætes were demonstrated in the blood of the mice both by dark-field examination and in smears stained by Giemsa's method. February 5, 1931, some peritoneal fluid from the mice was obtained, using fine capillary tubes. Smears were prepared and stained by Giemsa's method. A few spirochætes were demonstrated.

February 7, 1931, the guinea pig showed palpable inguinal lymphatic glands. February 9, 1931, the glands were larger, especially on the left side. From one of these some gland juice was obtained by means of a fine capillary tube and examined both by dark field and in smears stained by Giemsa's method. No spirochætes were seen by dark-field examination, but in the stained smears several spirochætes were seen. This was twenty days after the guinea pig was inoculated.

February 10, 1931, twenty-one days after inoculation, some peritoneal fluid was obtained from the guinea pig and examined both by dark field and in smears stained by Giemsa's method.

	Microns.	Coils.
Spirochætes from blood of RB–Ms–2 [a]	2.0	3
Do	2.5	4
Do	2.5	5
Do	2.5	5
Do	2.3	6
Spirochætes from blood of RB–Ms–1	3.6	7
Do	3.8	7
Do	4.98	9
Do	3.7	7
Spirochætes from tissue scrapings of patient	2.5	4
Do	3.0	5
Do	2.5	4
Spirochætes from gland juice of guinea pig RB–M–1	3.3	6
Do	2.4	4
Do	3.3	5
Do	3.3	5
Do	2.0	3
Spirochætes from blood of guinea pig RB–M–1	3.3	7
Do	2.5	3
Do	2.5	4
Do	2.5	5

[a] Measurements of the spirochætes were kindly taken by Dr. Marcos Tubangui jointly with the author.

No spirochætes were detected by dark field, but in the stained smears spirochætes were seen. It was not until February 15, 1931—that is, twenty-six days after inoculation—that the guinea pig showed the spirochætes in its blood. They were demonstrated in smears stained by Giemsa's method.

MORPHOLOGY AND MOTILITY OF THE DEMONSTRATED SPIROCHÆTE

Under dark-field illumination the spirochæte was seen as a rather short and rigid spindle-shaped organism, which darted back and forth very quickly and as quickly disappeared by shooting to one side. The spirochætes could be seen in the clear spaces between the red blood cells. The organisms moved so fast that details of their structure could not be observed. Only occasionally, when the spirochæte came to rest, could it be seen that its body is undulated, the undulations apparently lying in one plane. In stained smears the organism was seen to be much the same as Vandyke Carter describes it (called by him *Spirillum minus*) ; namely, that it is "an extended and uniformly slender filament of clearly spiral construction, having a length commonly somewhat less than the diameter of a blood disc but varying from 5 microns to 9 microns, and according to its length presenting from four to eight close spiral turns."

CONCLUSIONS

1. A clinically typical case of rat-bite fever was accidentally encountered among cases reporting for antirabic treatment.

2. The causative agent of rat-bite fever, *Spirochæta morsus muris*, was demonstrated in tissue smears from the patient and by inoculating it into experimental animals and recovering it from them by microscopical slides, stained and dark field. The spirochæte was identified morphologically and by measurements as well as motility to be *Spirochæta morsus muris*.

3. Thus the existence in the Philippine Islands of rat-bite fever was definitely established.

ACKNOWLEDGMENTS

To Dr. Otto Schöbl, chief of the division of biology, I wish to express my appreciation for suggestions offered.

To Lt. Col. Hayashi Hirano, Medical Corps, Imperial Japanese Army, now detailed at the Bureau of Science, I am also indebted for his coöperation in demonstrating the presence of the parasite.

ILLUSTRATIONS

PLATE 1

FIG. 1. Front view of the patient's face showing the site of the bite on the forehead and the lesion that developed at the site of the bite.

2. Showing the swollen cervical glands.

PLATE 2

Side view of the patient showing œdematous feature of the lesion on the forehead and the swollen cervical glands.

PLATE 3

Smears stained by Giemsa's method. Photomicrograms taken with ocular No. 4 and 1/12 oil immersion.

FIGS. 1, 2, and 4. Showing different sizes of *Spirochæta morsus muris* and its relation to the size of the red corpuscles.

FIG. 3. Two spirochætes joined end to end.

1

2

PLATE 1.

1

2

PLATE 2.

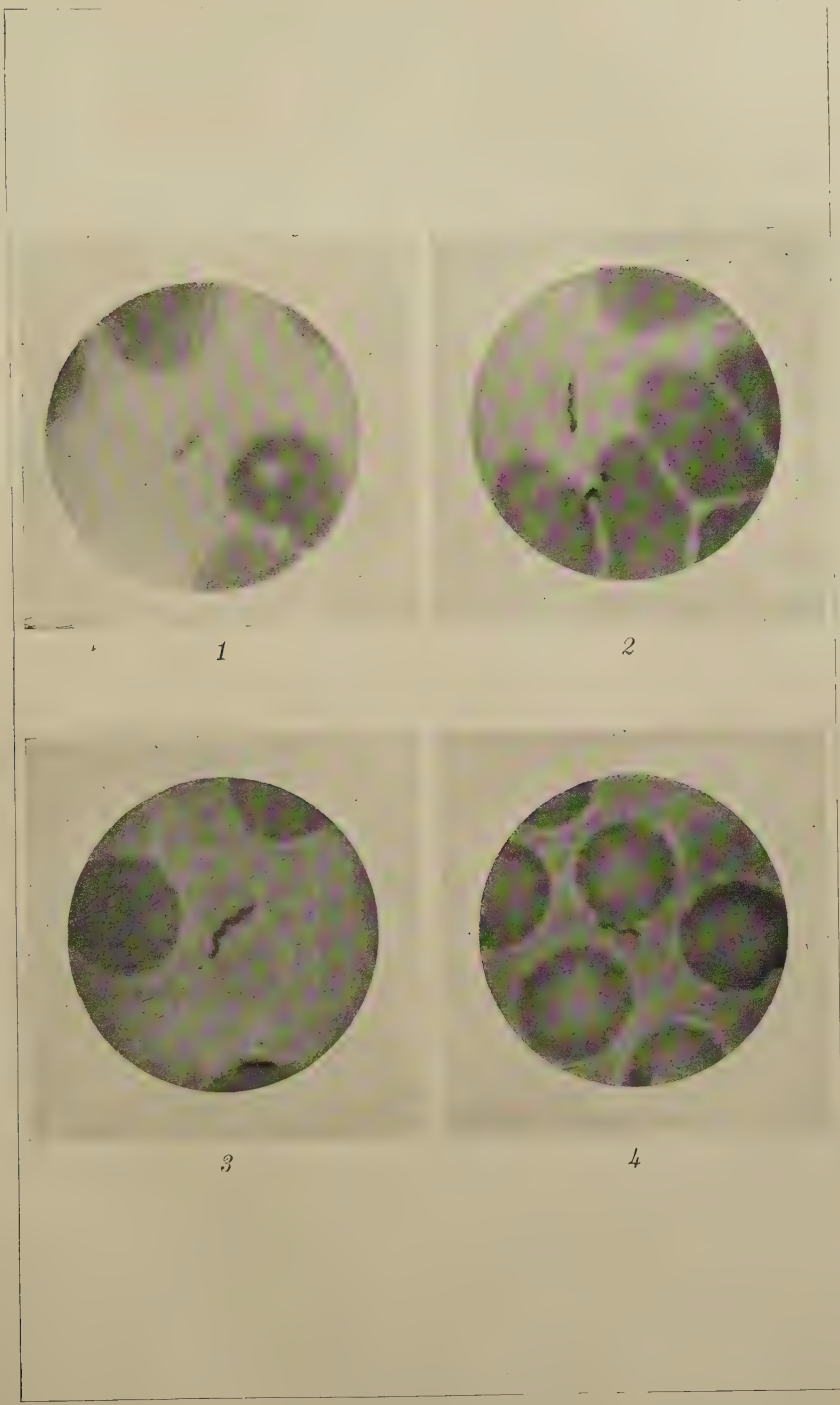

PLATE 3.

AN INTERPRETATION OF THE LAWS OF BROWN AND PEARCE THAT GOVERN THE COURSE OF TREPONEMATOSES *

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From the results of their classic experiments with syphilis on rabbits, Brown and Pearce deduced two laws that regulate the biologic events taking place during experimental infection and that are directly traceable in the course of natural infection in man. At least one of these laws was found by Schöbl [1] to apply to yaws as well, with a slight modification, conforming to the biologic nature of the parasite of yaws as it differs from that of the parasite of syphilis. Clinical observation showed that the law, which holds true in experimental yaws in animals, likewise applies to natural or experimental yaws infection in man. The two are known as the law of inverse proportions and the law of sequence.

The law of inverse proportions, as it applies to both syphilis and yaws, says: The more intensive the early manifestations, the less intensive are the late manifestations of the disease. This law, as expressed above, applies as much to syphilis as it does to yaws. In syphilis, however, it enters into play in the relation between the primary and the secondary stage, as well as between the secondary and the late manifestations; while in yaws it is true only between the early stage on the one hand, and the late manifestations on the other.

The second law of Brown and Pearce is the law of sequence. The various systems of tissues are affected successively. This law is clearly evident in human syphilis where the integument, the internal organs, the cardiovascular system, and the central nervous system are affected successively and in combinations with great regularity. In yaws this law has little application due to the epidermotropic tissue selectivity of the parasite that

* Received for publication February 5, 1931.

[1] Philip. Journ. Sci. 35 (1928) 211.

causes this disease. While early yaws lesions are restricted to the skin exclusively, the late ulcerative lesions also occur in the skin but may by continuity migrate into the tissues immediately attached to the integument. Thus subsequent to an ulcerative skin lesion the muscle, the periost or cartilage, and even the bone may be affected by an hypertrophic, atrophic, or ulcerative process originating in the skin. By the time the lesion is seen in the clinic the original skin lesion may have healed by scars while the lesion in the bone, for instance, may persist at the time when the patient is first seen. It is nothing but a part of the original skin lesion that migrated, healing as it traveled. The entire course of development of such lesions is never seen in the clinic. The clinician has entered the theater in the third or last act of the drama. Unless these lesions are experimentally produced and followed step by step, the pathogenesis of late yaws lesions remains an unsolved mystery to the clinician, who is surrounded on a yaws clinic by a veritable kaleidoscope of chronic clinical phenomena, the past and the future of which may never come within the range of his vision.

The present author is unaware of an adequate interpretation, or any at all, of the laws as first formulated by Brown and Pearce. In the course of experimental work on yaws and syphilis, performed partly on human volunteers and partly on suitable animals, which the present author has carried on in the course of the last seven years, certain findings were made that correlated themselves, as the work progressed, into a logical chain of what appeared to be natural causes of the nosologic phenomena that form the clinical course of treponematoses and for which laws were deduced by Brown and Pearce.

The first observation in this direction was made when it was found that the intensity of early yaws lesions stands in direct proportion to the number of treponemas contained therein.[2] Since the intensity of the early lesions stands in inverse proportion to the intensity of the late lesions, in yaws as well as in syphilis, the law could be expressed thus: The relative number of invading parasites in the early stage of infection stands in inverse proportion to the intensity of the late manifestations.

The second finding was that the serologic response due to superinfection stands in inverse proportion to the serologic response of the original infection.[3] The law of inverse propor-

[2] Philip. Journ. Sci. 35 (1928) 257.

[3] Op. cit. 272.

tions was found reflected in the serologic picture of experimental yaws and syphilis.

The next link in the chain of experimental results was the finding that a time relation exists between the late serologic response and immunity.[4] At the time the late response becomes apparent in the form of strong serologic reactions the resistance to superinoculation is fully developed, and any experimental procedure that accelerates the late serologic response hastens the development of resistance to superinoculation or reinfection. From our early experiments with yaws it is known that no new lesions form, either secondary or late ulcerative ones, from the time the yaws monkeys become immune to superinoculation; but the respective generalized or late ulcerative lesions that have developed before that time persist. We formulated this finding in the statement: The time during which the secondary or the late ulcerative yaws lesions form is limited by the development of immunity and is shorter than the time necessary for the healing of the already existing lesions. Prior to the onset of such a high degree of immunity that it completely prevents the formation of specific lesions at the place of superinfection, metastatic lesions develop that are atypical and have been called by us frambœsides. Late ulcerative lesions may form at the place of superinfection at this time.[5] Both types of lesions contain such a small number of treponemas that it is difficult and frequently impossible to demonstrate their presence in the lesions by dark-field microscope. These lesions occur after the typical ones and before complete resistance sets in. From these experimental findings we have deduced the explanation that partial immunity is responsible for the modification of the morphology of treponematous lesions.

The law of inverse proportions, which is the first law of Brown and Pearce, can be expressed as follows: The number of the invading treponemas during the early stage stands in direct proportion to the degree of immunity that subsequently develops. It stands in inverse proportion to the time necessary for the development of immunity, or in other words, the number of invading parasites in the early stage of infection stands in direct proportion to the speed with which immunity develops, the speed being the ratio between quantity and time. This law of direct proportions between the number of invading parasites

[4] Philip. Journ. Sci. 42 (1930) 203; 43 (1930) 603.
[5] Philip. Journ. Sci. 35 (1928) 230–236; 242–251.

and the speed of development of consequent immunity applies not only to the living parasites but also to the lifeless antigen, to the infection and the following vaccination or vice versa. Thus the law has a general application and can be finally formulated as follows: The degree of subsequent immunity and the speed of the development of immunity stands in direct proportion to the amount of treponematous antigen. Due to this direct proportion between the treponematous antigen and the subsequent immunity, the immunity stands in indirect proportion to the duration of the clinically active disease.

The law of sequence indicates successive involvement of various tissue-systems by the syphilitic infection. The treponemas invade the blood stream from the initial portal of infection in its early stage. This is true of syphilis as well as of yaws. In the case of yaws, contrary to syphilis, the parasites do not colonize the internal organs permanently and do not produce lesions in these organs. In the case of syphilis, the parasites remain viable in the mesoderm for a very long time, if not for life.

The treponemas being disseminated into the various tissues through the blood stream in the very early stage from the portal of infection, the law of sequence is not based on a successive invasion of the various tissues by the parasites. The integument comes in contact with the treponemas first of all. They invade the internal organs in the early stage of infection, but the heaviest immigration into these organs takes place when the treponemas are present in the largest numbers in the initial lesion; that is, at the time when the initial lesion is fully developed. Thus the tissues of the integument, which form the seat of the initial lesion, in a typical clinical case of syphilis pass from the stage of sensitization through the negative phase into the positive phase somewhat ahead of the other tissues. The immunity is transferred from one to the other systems of tissues; first in the form of a delayed incubation period, then in the form of a changed clinical and anatomical morphology of the lesions. It is very likely true of all infections, but in treponematoses, and particularly in syphilis, it is clinically evident that before immunity becomes fast a more or less pronounced oscillation between the negative and positive phase of immunity takes place. This swinging of the pendulum between the positive and the negative phase is not necessarily synchronic in all tissues, because even in normal skin the incubation period of two or more experimental lesions produced

by simultaneous inoculation of the same amount of the same yaws-inoculum, by the same method, and under the same tissue conditions, even in symmetric parts of the same animal, is not always the same. Thus the fate of a focus of treponemas deposited in a given tissue, in the course of treponematous infection, is influenced by the phase of the transmitted immunity due to the activity of another focus of treponemas deposited in another place of the same or in another system of tissues. An almost healed yaws lesion was brought to an extensive exacerbation, and dormant deposits of yaws treponemas were incited to formation of lesions, after an extraordinarily long incubation, by superinoculation with syphilis that failed to produce syphilitic lesion. On the other hand superinoculation of yaws monkeys with syphilis that produced syphilitic lesion resulted not in exacerbation of the existing yaws lesion but in a striking acceleration of yaws-immunity.[6] This shows that immunity in its negative as well as in its positive phase is transmitted between tissues.

An immunity that is on an upgrade incline may be accelerated into the positive phase, while the immunity in another part of the same system of tissues or in different systems of tissues that is on the downward incline may be accelerated into a deeper negative phase by superinfection than would be otherwise possible. It is clearly evident that spontaneous exacerbation of a lesion takes the place of an experimental superinfection in this respect. One is a superinfection from within, the other from without. The decisive factor is the sudden increase of treponematous antigen, dead or alive, that is brought in contact with mesodermic tissues in these instances. The variation of the incubation period, which is made much more elastic by the initial immunity, makes incalculable the possible effects of the intermingling immunity-phases on the course of the main immunity curve, which in itself is not steady. They can, however, be predicted in a general way.

The second law in syphilis of Brown and Pearce, that is, the law of sequence, is here interpreted as a sequence of immunity that develops successively in the various systems of tissues. The treponemas that invade the various tissues, long before the immunity has developed, can multiply and produce lesions only in those tissues that are not yet immune. Not all tissues are equally capable of producing immunity in treponematoses. This

[6] Philip. Journ. Sci. 42 (1930) 239.

is evident from the findings that treponema pertenue introduced into the epiderm causes immunity to develop in six months; when introduced into the mesoderm in six to eight weeks.[7]

The explanation given here, that is, the successive transmission of immunity from tissue to tissue, explains the well-known clinical observation that specific syphilitic lesions develop in the internal organs or in the central nervous system in a host whose integument has long become immune to reinfection and to relapses. A better explanation of the condition known as neurosyphilis is to assume that due to insufficient immunization in the early stage of the infection, which may have been caused by mild early lesions, by insufficient sterilization of the host, by treatment given in the early stage of the disease, or by superinfection, taking place in a partially immune body, it may have assumed the symptomless form, rather than the explanation given at times in the literature that, due to the modern arsenical treatment, the syphilitic infection becomes neurotrophic. Strains of treponema pallidum isolated from neurosyphilis produce typical chancres in experimental animals and otherwise behave like any other strain isolated from a primary lesion. They do not show any signs of permanent changes in their biology and behave differently in the body of the neurosyphilitic case, from which they were isolated, on account of the changed condition of that particular patient's tissues and not on account of a change in the biology of the parasites. A simple experiment convinced us of the truth of our supposition that immunity in syphilis involves the various tissues at different stages and in succession. A series of yaws monkeys inoculated with yaws more than a year prior to this experiment, and that repeatedly had been proven immune to yaws were inoculated with Nichols strain of syphilis on one side of the scrotum *intradermally*. No lesion developed at the place of inoculation but the normal control animal developed a typical sclerosis. In due time the corresponding inguinal glands were excised and transferred to rabbits' testicles. None of the rabbits that received the glands from the immune monkeys developed lesions and they were found susceptible to syphilis five months later. Thus it was proven that the lymph glands contained no treponemas. The rabbits that received the lymph glands from the nonimmune controls developed typical chancres. Thus it was proven that the inoculum contained viable virus of syphilis. Two months

[7] Philip. Journ. Sci. 35 (1928) 280; 45 (1931) 221.

later the immune monkeys were reinoculated with syphilis by *intratesticular* injection on the opposite side from the point where the first inoculation with syphilis was introduced. The lymph glands, corresponding to the place of the second, the *intratesticular* inoculation, were transplanted to rabbits. One half of the rabbits developed chancres and the other half remained normal. The latter animals were found susceptible to syphilis five months later. This experiment shows that all of the animals immune to yaws were also immune to syphilis as far as *skin* was concerned, but only some were immune to syphilis with regard to *internal organs* at that time. Two months after the *skin* immunity was established the *internal organs* concerned were immune only in some of the experimental animals and not in others.

SUMMARY

The law of inverse proportions of Brown and Pearce is interpreted as a direct proportion between the quantity of treponematous antigen, dead or alive, and the degree of immunity and the speed of its development. The law of sequence of Brown and Pearce is interpreted as a successive development of immunity in the various systems of the body's tissues.

This interpretation, based on experimental facts, brings these laws in agreement with the laws that govern antibacterial immunity, and is a contribution to the knowledge of tissue immunity.

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COEXISTENT INFECTION WITH YAWS AND SYPHILIS

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Clinical observations made on man and experimental experience with humans and animals, show that yaws infection can supersede that with syphilis and vice versa. This phenomenon has been interpreted in various ways in the past. Those authors who maintained that yaws and syphilis are distinct and different diseases used these observations as proof of their dualistic interpretation of the treponematoses, while the opposite side claimed that lesions were found in yaws patients that could not be distinguished clinically from syphilitic lesions and deduced that yaws and syphilis are one disease.

The new designations that are given by the unitarians to yaws such as "tropical syphilis," "primitive syphilis," and "rural syphilis," to distinguish yaws from "civilized syphilis," or "city syphilis," prove ipso facto that all is not well with the unitarian theory or else such differentiation in designations would not be necessary. It appears from the literature that the possibility of coexistence of the two diseases in one and the same patient, and particularly the influence that coexistent infection with syphilis may have on the clinical course and manifestations of yaws or vice versa, have not been considered.

Unfortunately, the question of the relation between yaws and syphilis is a far deeper problem than merely one of clinical nomenclature. It is a question of different organotropism of the treponema of yaws from that of the treponema of syphilis. It is not an isolated phenomenon and finds its analogy in certain relations of leprosy to tuberculosis, of herpes to encephalitis, and probably of dengue to yellow fever. The question of organotropism with regard to infection and immunity very likely has more general application than is suspected today, and the once inviolable laws of specificity of infection and immunity are being modified constantly, as is also our conception of immunity.

The experimental evidence that has come to light through our researches,[1] which shows that reciprocal immunity exists between yaws and syphilis, does not prove that the two diseases are one and the same, as it appears to at first sight. On the contrary, the difference in immunologic conditions existing in yaws and in syphilis, both in animals and humans, as well as the difference in the behavior of the two infections with regard to cross immunity, shows plainly that fundamental immunologic differences exist between yaws and syphilis. These differences, like those of the tissue selectivity of the respective parasites, the pathology, pathogenesis, clinical course, transmission, geographic and age distribution, stand in complete agreement with the fundamental biologic distinction between the parasite that causes yaws and the parasite that causes syphilis.

Experimental evidence shows that infection with syphilis may have a decided effect on the course of a coexisting yaws infection. This effect is evident in two directions. According to the stage of immunity that is present at the time when the syphilitic lesion develops in a yaws-infected host the immunity may swing into a negative phase and exacerbations or relapses of the basic infection may occur.[2] On the other hand, the immunity may swing rapidly into the positive phase[3] and the effect of such cross superinfection will be beneficial to the host, inasmuch as the rapidly accelerated immunity prevents the development of further stages of both yaws and syphilis.

Therefore, it is quite evident that syphilitic lesions, as well as yaws lesions, may coexist in one and the same host just as leprous lesions and tuberculous lesions may coexist in the same patient. This coexistence certainly does not justify the conclusion that syphilis and yaws are one and the same disease. If lesions that cannot be differentiated anatomically from syphilitic lesions are found in internal organs of yaws patients, such as the cardiovascular system or the placenta, there is every reason to assume that these lesions are of syphilitic rather than of frambœsic origin, and the possibility of a double infection must be considered in such cases. There is hardly a corner of the world where syphilis has not been introduced. A statement made in German literature that Nichols strain of yaws, after repeated passages through rabbits over a period of two years,

[1] Philip. Journ. Sci. 42 (1930) 203, 239; 43 (1930) 263, 429, 583; 45 (1931) 221.

[2] Philip. Journ. Sci. 42 (1930) 245.

[3] Op. cit. 241.

changed its character suddenly so as to become indistinguishable from that of syphilis, merely shows, provided that no error was committed since both Nichols strain of yaws and Nichols strain of syphilis have been imported to Germany, that the experimental animal used, the rabbit, is unsuitable for the study of yaws. The subject to be studied, yaws, became unrecognizable in this kind of animal. Retroinoculation to men or to a Philippine monkey would be the only procedure in such a case.

The frequent and unduly exaggerated statements that yaws lesions cannot be differentiated from syphilitic lesions clearly prove that mere clinical inspection, unsupported by other methods and procedures of biologic investigation, has its limitations, which must naturally vary with the dermatologic training and experience of the observer.

The crucial test that decides whether a given doubtful lesion is of frambœsic etiology is the inoculation of the material obtained from this lesion to a suitable experimental animal. Thus, an atypical yaws lesion in a patient, with which the diagnostician may not be acquainted, is reduced to a typical initial lesion of yaws in a suitable animal and may be easily recognized even by a less trained or less experienced physician. Due to the great morphologic similarity of *Treponema pertenue* and *Treponema pallidum* the mere microscopic demonstration of treponemas in smears or sections cannot settle whether a given lesion is of frambœsic or syphilitic origin. By inoculation of the material from atypical yaws lesions to monkeys, we were able, on several occasions, to confirm our clinical diagnosis of yaws and to convince the attending physician that the lesion was yaws and not syphilis.

It must be borne in mind that the treponematoses are chronic infections, that the immunity develops slowly, that there is a great number of possibilities in the scale of immunity from complete susceptibility to complete immunity, and that the quantity of early infection affects the progress of the immunity in direct proportion as to degree and in inverse proportion as to time.

The possibilities are further augmented by the mutual interference of cross immunity between yaws and syphilis. The degree of immunity at a given time in the course of a treponematous infection has a deciding effect on the modification of subsequent clinical lesions. Not only the homologous but also the cross immunity between yaws and syphilis modifies mutually the clinical character of the lesions and the course of the dis-

eases. This modification varies according to the degree of immunity existing at a given time. A treponematous lesion develops when the parasites propagate at a given site in the host's body tissues. Immunity of low grade restricts the propagation of treponemas lodged in the tissues and a modified or atypical lesion may develop. The highest grade of immunity suppresses completely the propagation of the parasites in the tissues and no lesion develops. This is true of homologous as well as of cross immunity between yaws and syphilis. When a host infected with yaws develops no lesion at all at the place of homologous superinoculation, the infection is brought to a standstill and no new yaws lesions will develop. The host has reached a high degree of homologous immunity. At that time, however, he has not yet become immune to cross infection, and if originally infected with syphilis, for instance, may contract yaws, with either a typical or modified course, for some time after the superinfection with syphilis no longer produces a lesion. From this it follows that simultaneous or subsequent cross infection with yaws and syphilis is to be considered as a probability in a clinical case. A cross infection is possible beyond the time when a high degree of homologous immunity has developed and up to the time when a group immunity develops, which then includes not only homologous but also heterologous treponematous infection as well. The condition of tissue nonreactivity that develops in syphilis after the infection has lasted for some time is frequently referred to as anergy. This term, however, is misleading as to the nature of this tissue condition, insinuating, as it does, a property of tissues that has been lost rather than a property that has been gained. Animals infected with syphilis in our experiments soon reached a stage in which a subsequent homologous superinfection no longer produced a lesion. The absence of lesion at the place of superinfection is due to the inability of the parasites to multiply and the non-development of the lesion is due to this factor and not to the inability of the tissues to react. The parasites do not multiply under these conditions and consequently do not exert sufficient irritation to cause the tissues to react. When the very same syphilitic animals that failed to develop lesion as a consequence of superinfection with syphilis were superinfected with yaws, the tissues reacted promptly and a yaws lesion developed, showing that the tissues were capable of reacting to the introduction of parasites for a considerable time after they no longer reacted to the homologous superinfection and before

the cross immunity to yaws developed in syphilitic animals. There seems to be no reason why this phenomenon of so-called anergy should not be interpreted as immunity, which suppresses the propagation of the parasites either completely or at least partially.

The clinical result of cross infection with yaws and syphilis may be either an exacerbation of the basic, as well as of the subsequent infection, or the subsequent cross infection may bring about a partial or complete suppression of both coexisting syphilis and yaws, in which case further stages of both diseases will be limited or completely suppressed. Which of the two possibilities will happen depends on the degree of immunity present at a given stage of the disease.

THE PROSPECTS OF VACCINATION AND VACCINE THERAPY IN TREPONEMATOSES *

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The clinical course and the ultimate result of treponematous infections, like those of any other infection, are determined by the biology of the parasite and by the immunity that develops in the course of the infection. Whether the innate nature of a parasite is to multiply consecutively or intermittently, that is in a cycle, the parasites should propagate progressively in the body of the host and the inevitable consequence thereof should be the death of the host. This, however, is not always the case even in the most acute infections and it rarely occurs in such chronic ones as the Treponematoses. The chain of subsequent biologic events that take place in the course of treponematous infections, which are the result of mutual interaction between the parasite and the tissue response of the host, may be spoken of as immunity in "statu nascendi." The ultimate immunity prevents the parasites that have invaded the tissue of the host, previous to or subsequent to the full development of immunity, from further propagation. No new lesions develop from that time on. Definite and well-known laws govern the clinical course of treponematoses from the beginning of the infection to the end. These laws are determined by a quantitative relation between the parasites and immunity. There exists a direct quantitative proportion between the number of parasites present in the body of the host and the degree of subsequent immunity, and an inverse proportion between the number of parasites and the time necessary for the development of immunity. The more parasites there are present in the early stage of the infection, the higher the degree of immunity that will develop, and the quicker it will set in. The clinical course of the infection in treponematoses and its consequences are determined in

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the early stage of the disease by the relative number of parasites. The earlier the immunity develops, the shorter and less tragic is the course of the disease. Further progress of the disease is halted in any stage of the disease whenever full immunity sets in. The immunity in treponematoses can be accelerated by artificial means, and the course of the disease can be influenced thereby. A high degree of immunity can be made to set in before the expiration of the incubation period of the primary, or of the generalized so-called secondary manifestations or of the late forms.

The experimental evidence on which these statements are based has been published, likewise the possibility of preventive vaccination and vaccine therapy in treponematoses has been demonstrated on animals. It is the object of this communication to discuss the mechanism of these vaccination procedures in order that an appraisal of the practical possibilities may be realized.

The intimate relation between the serologic response of the infected body organism and the stages of immunity in statu nascendi in the course of treponematous infections is unquestionable. Coincidently with the development in animals of the primary lesion, which is the clinically visible sign of sensitization, and provided that only local lesion develops in the course of the infection, the curve that registers the results of serologic examinations rises to a more or less high point, the strength of the serum-reactions being directly proportional to the intensity of the lesion, in other words to the number of parasites present in the primary lesion. With the healing of the primary lesion, the serologic curve returns to normal, only to rise again to the highest point at the time when a high degree of immunity sets in.

In animals immunized with lifeless treponematous antigen, only the early serologic response becomes evident, that is, the one which is coincident with the primary lesion in case of infection. The late response is absent in case of vaccination with killed treponemas, or it is possible that it is very much delayed.

If generalized manifestations appear, following the development of the initial local lesion, the late serologic response as well as the development of immunity is accelerated. An analogous phenomenon occurs if infection takes place following vaccination with killed treponemas, that is, a sudden rise of the serologic

curves and acceleration of the development of immunity. We may express it in the following way. From the serologic and immunologic standpoint, the preventive vaccination takes the place of the primary lesion, and the infection that follows the preventive vaccination takes the place of the generalization of the treponematous infection, the so-called secondaries. Clinically speaking, there are several possibilities when treponematous infection invades the vaccinated body organism. The result depends on the time relation between the incubation time of the infection and the speed of the acceleration of immunity as a consequence of the infection itself. If the time necessary for the accelerated immunity to reach a high degree is shorter than the incubation of the infection in the vaccinated body organism, then no lesion develops. If the time required by the immunity to be accelerated to a high degree by the subsequent infection is longer than the time of incubation, a local primary lesion develops, but the immunity is raised thereby, to a high grade, before the time when the generalized manifestations (the secondaries) or the late forms (the tertiaries) can occur. Consequently, following the primary lesion, no subsequent stages of the disease develop.

Specific antitreponematous treatment, when administered in the early stage of a primary lesion, delays the onset of immunity far beyond the time at which immunity sets in if infection is allowed to run its course without treatment. Under these circumstances treponematous reinfection or relapses, if the treatment was not complete, are possible for a long time. Vaccine therapy, administered after early specific cure, accelerates the immunity. Within a short time after the vaccine therapy has been administered a reinfection is no longer possible. The primary lesion is accompanied by a rise in the serologic curve, which drops to zero following the treatment. The development of immunity is delayed by early treatment, and the earlier the treatment is administered the more is the immunity delayed. In other words, a primary lesion whose progress has been terminated by early specific treatment has the same serologic and immunologic effect that vaccination with killed treponemas has in healthy animals. Intramesodermal incorporation of antigen, living or dead, causes a rapid development of immunity. Thus reinfection after early cure may be prevented by vaccine

therapy, or in case that primary lesion develops due to reinfection no further stages of the disease will develop.

Vaccine therapy administered to an infected host without previous or simultaneous specific antitreponematous treatment provokes a negative phase and severe lesions may appear in such a case.

The most opportune time for an effective application of antitreponematous vaccination, either before natural infection has taken place or after the body organism has been infected, is the stage of normal or the stage of exaggerated tissue reactivity. When the tissues reach the stage of diminished reactivity the effect of the antigen supplied by vaccination will be slight or nil. The immunity in treponematoses runs the general course of a saturation curve. It follows inevitably from the shape of such a curve that its rise can be influenced effectively in the initial phase, somewhat in the middle phase, and very little, if at all, in the last phase of the curve. In order to be effective the vaccination with killed treponemas must take the place of a vigorous infection of the early stage so that, according to the law of inverse proportions of Brown and Pearce, the subsequent stages of the disease are very mild or do not manifest themselves at all. Whether administered to a healthy body or to a previously infected host the antitreponematous vaccination is a preventive measure and tends to hasten an immunity that, in turn, prevents the development of subsequent stages of the disease. It has no apparent healing effect on the lesions that have already developed. The vaccination with killed treponemas is a controllable and harmless substitute of a severe early treponematous infection that, as experimental evidence and clinical observation show, prevents the development of late stages of the disease.

These statements with regard to vaccination and vaccine therapy are based on experimental evidence and refer to experimental animals.

A fair estimate can be made of the possibilities of vaccination and vaccine therapy in treponematous infections in man. This estimate has not been made by merely applying the experimental findings made in monkeys to man, but by drawing a comparison between the conditions experimentally found in monkeys and the conditions that were found in experimentally inoculated humans. No rational objection can be held against such comparison, particularly in the case of yaws, since it has been proven that by appropriate experimental procedure an infection can be produced in monkeys that runs the same course and manifests

itself in these animals in the same principal forms as does the disease in human beings.

The incubation period of the primary yaws lesion, and of the generalized so-called secondary stage in monkeys, is the same as was experimentally found in humans. In monkeys the immunity sets in earlier than it was found to take place in experimentally infected human volunteers. This finding explains the fact that the period during which generalized and late yaws lesions crop out in monkeys is shorter than in man. From this comparison, it is safe to predict that the effect of vaccination in human treponematoses will not be as prompt as in experimental animals. The degree of immunity, however, in these infections, as well as the rapidity of its development, depends on the amount of vaccination and on the proper time at which immunization is carried out. Furthermore, experimental inoculation is a far more severe test for immunity than the one that is usual in the great majority of natural infections of man. We may, therefore, rightfully hope that this procedure will be a valuable addition to our present armament for combating human treponematoses, that is yaws and syphilis.

DECAY OF WOOD IN AUTOMOBILES IN THE TROPICS

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TWO PLATES

The depreciation of automobiles in the Tropics from decay of the wood used in their construction reaches a staggering figure in proportion to the investment. The various kinds of timber used in their manufacture are not, as a rule, adapted to withstand the warm humid weather to which the cars are constantly subjected. As a result of this the timber replacement business, in the City of Manila alone, has become a considerable industry.

Most of the cars in the Philippines are of American manufacture; a few come from Europe. The woods used are almost exclusively native temperate-zone species selected for their strength, toughness, workability, etc., rather than for their durability. In American cars [1] ash, beech, birch, elm, hickory, maple, oak, and sycamore are commonly employed in places requiring strength. Hickory is regularly used for spokes and rims; oak for top bows. For running boards, seat risers, seat lids and other parts not requiring strength, chestnut, gum, tupelo, yellow pines, Douglas fir, etc., are commonly employed. With the exception of white oak, chestnut, resinous yellow pine, and heart red gum these are all recognized as being only moderately resistant to decay. When sapwood is used it is very perishable regardless of the durability of the heart.

The automobile and truck business in the Tropics has reached a considerable volume, the registration [2] for 1929 in the Philippine Islands being 21,341 passenger cars and 10,365 trucks, of which 9,545 cars and 2,965 trucks were registered for the City of Manila. The turn-over of used cars is comparatively large, this being to an appreciable extent occasioned by the rapid deterioration of the wooden parts. Many people prefer to dispose of a car that has seen service of one or two years rather than

[1] Information published by Mr. Luis J. Reyes in the special forestry edition of the Manila Daily Bulletin, summer of 1928.

[2] Data furnished by the Bureau of Public Works, Manila.

submit to the inconvenience and expense of dismantling the body for the purpose of replacing the timber. It is at best a gamble as to the extent of renewals necessary, for a proper estimate of cost can only be reached by fully exposing all the wood. Estimates made on any other basis are usually high, in order to take care of the probable deterioration of unseen parts. The writer has rebuilt the bodies of two cars and in both cases practically all of the wood needed replacement.

Often the deterioration becomes distinctly noticeable within the first year's service, and there are many instances where extensive repairs have been necessary at the end of two years, or even within one year. For cars in service longer than two years it is safe to assume that decay is at least well started at some important point (Plates 1 and 2). It impresses itself upon the attention when the sills and vertical members have become sufficiently decayed to permit the doors to sag and be thrown out of alignment. Top members upon which any weight is hung, such as the wind shield, also begin to rattle or give way entirely. The decay may also spread to the upholstering or even affect the top covering.

Repair work in the Philippines is not very thorough, as a rule, partly as a result of the desire to keep the cost down, partly through ignorance as to how wood decay develops and spreads. Another factor in the situation is the trading in and resale of used cars after conditioning them at the least possible expense. A splice here and there, a few bolts tightened, a new coat of paint, a new bit of upholstery, and perhaps a new top covering, work wonders in appearance and often hide from the unwary the more serious defects within. Even in what are considered bona fide jobs the contractor often uses poor judgment in failing to take out timber showing early stages of infection, little realizing that all traces of the wood-decaying organism must be eradicated if the further spread of the decay is to be stopped. It is often false economy to splice, and if the top framing or the sills show considerable decay at the joints or elsewhere the better procedure is complete replacement. This opinion is based on the assumption that if the timber is so perishable as to rot out at any point within a short period it will continue to do so, the probabilities being that the replacements will out-last the original timber left in and necessitate further repairs within a short time.

WHAT CAUSES DECAY

Decay is conditioned upon moisture. Free water must gain access to the wood in some manner. This may occur indirectly by condensation when a cool surface is in contact with a saturated atmosphere, or directly, through a leak in the top or elsewhere, or when beating tropical rains force in moisture around the closed doors and windows. Much wetting of the sills also occurs through negligence in leaving doors or windows open during storms, and some of it occurs during the process of frequent washing.

Wet wood in a car dries but slowly, for it is usually covered. When water reaches a joint it penetrates deeply and gets well into the interior of the timber at the joined ends. This end penetration of moisture into wood is very rapid and easily demonstrated. It is thus a simple matter for water to enter at the joints but very difficult for it to get out, even in rather dry weather. When one stops to consider, however, that during a tropical rainy season over 100 inches of rain may fall and weeks may pass with the air at or near saturation, it is small wonder that cars built of perishable wood deteriorate rapidly. Six months under test conditions very highly favorable for decay will destroy for practical use nearly all the temperate-zone woods now used in American or European-made cars.

The next question that arises is what agent causes this deterioration. It is all due to the presence of fungi belonging to the more highly organized groups, principally the Hymenomycetes. These fungi are plants fundamentally differing from ordinary plants only in the lack of green coloring matter and the method of nutrition. Ordinary plants must get their food from the soil and air, therefore, they must have the green coloring matter to act as a catalyst in the manufacture of carbohydrates needed for growth. Fungi get all their food from the organic substances upon which they grow, therefore, there is no need for chlorophyll. They must, however, produce ferments to render soluble and assimilable the various chemical substances of which their substratum is composed. Wood-destroying fungi are abundantly supplied with the ferments necessary to decompose the compounds in wood, of which the principal ones are cellulose and lignin, with some sugars and starches.

Wood-destroying fungi require for growth a small quantity, of air, a favorable temperature, suitable kinds of wood, which

do not contain substances poisonous to, or inimical to, the growth of the organisms, and a considerable amount of moisture. The first and second requirements are met at all times in the Tropics, where the temperature rarely goes below 60° F. and most of the time is around 80°, or somewhat above. The third condition is met when perishable woods such as are ordinarily employed in automobile construction are used, and this is particularly true of the sapwood of practically every species of tree known. The third condition is readily met in the Tropics, where high humidities and heavy rainfall prevail, and is accelerated by the factors mentioned in the third preceding paragraph. While scientific knowledge of the exact amount of moisture most favorable to decay is lacking, enough data have accumulated to indicate that the amount will vary for the kind of wood under discussion. It is quite safe to say that ordinary absorption of moisture from a saturated atmosphere (fiber saturation point) is not sufficient for decay and that a certain amount of free water must be present in the cavities of the wood cells or fibers for the fungus to grow vigorously and break down the structure rapidly.

LIFE CYCLE OF WOOD-DESTROYING FUNGI

The life cycle of wood-rotting fungi is quite simple. Each fungus has two principal stages of growth, the sporophores, or fruiting bodies, which take the place of the seed-bearing apparatus of green plants, and the mycelium, which functions within the wood as an absorbing system comparable to roots. The mycelium is the stage that causes the damage. It consists of fine cottonlike branched threads, which ramify throughout the wood tissues and by the secretion of various ferments cause their disintegration. These threads develop abundantly in any closed-in moist space and may thus spread rapidly over the surface of such inclosed timbers (Plate 2, figs. 7 and 9), as well as within them.

After the wood becomes partially decayed the fungus attempts to form fruiting bodies on the surface. These are very often abortive and may consist only of cushions of compact mycelium when developing in the dark, but when they have access to light they take on a more or less definite form by means of which they can be identified. Such fructifications developing in the light soon become fertile; that is, the outer surface of such types as grow in a thin layer flat against the wood, or the under surface of shelving forms, produce large quantities of spores that are

comparable to seeds. These spores are very minute and easily disseminated by air currents. When they lodge on the surface or in the joints of moist wood, or even on wet cloth fabric, they readily germinate to produce another crop or mycelial threads, which in turn quickly penetrate and rot the material. In this way organic construction materials are constantly subject to infection, and when conditions are right for germination and growth of the fungi, and the wood is not resistant to attack, disaster comes.

Up to the present time only three species of fungi have been observed fruiting on automobile wood; namely, *Lenzites striata* (Plate 2, fig. 10), *Polyporus sanguineus,* and *Trametes versatilis,* but there are, in all probability, a number of others that have not been found in fruiting condition. These species are inhabitants of warm regions and are well represented in the Philippines as well as in the southern United States. They are all species that are resistant to drying, to rather high temperature, and to bright sunlight, as is evidenced by their frequent occurrence on timber in the open, rather than in the shady, cool, moist forest. There are a number of other such resistant species that one would expect to find attacking automobile bodies, exposed as they are to such fluctuating climatic conditions.

It appears probable that the infection of the wood occurs after the cars reach the Tropics. This would certainly be the case if all the wood going into their construction were kiln dried before use, for the usual processes of artificial drying sterilize timber quite effectively.

PREVENTION OF DECAY

On this assumption then, what can be done by the manufacturer to adapt his product to tropical conditions? There appear to be but two alternatives; either he must select the heartwood of reputedly durable species of timber, or else the nondurable woods now in use must be treated with a preservative.

It is said that durable tropical woods are being used in certain European-made cars and that these are giving very good service in the Tropics. American manufacturers may use a few exotic woods for trim, but their inclusion as principal members has never come to the attention of the writer. There are a great number of Philippine woods that are well adapted to automobile construction and that combine high resistance to decay with the other mechanical properties desired. The difference in cost of these superior tropical woods is a very small item in the total

cost of manufacture and could readily be absorbed through the increased business incident to the production of a car that would stand up under severe conditions for a reasonable length of time. It is absurd for a manufacturer to spend millions on improved mechanical development and then house it all in a rotten shell.

Whether it would prove more economical to import these tropical woods into the States for use in cars destined for the Tropics or to thoroughly impregnate the nondurable American woods now in current use is a matter for the manufacturer to decide after checking up the respective costs. Either procedure would be satisfactory from a durability standpoint. It is safe to say that wood-frame cars in the Philippines are now at a serious disadvantage and are becoming increasingly unpopular. Steel is giving good service and discriminating buyers are turning more and more to it from the standpoint of both service and safety.

METHODS OF APPLYING WOOD PRESERVATIVES

The American manufacturer who wishes to use wood preservatives has at his call a well-developed industry using standard and proven processes, but if he should wish to treat his own stock a suitable small pressure plant could be installed at a very moderate cost.[3] At present a small amount of treated timber is being used in American-made cars, but it is insignificant and not at all commensurate to the needs. It is unnecessary to go into the details of treating methods other than to state that pressure treatments are indicated. The principal commercial substances injected into wood to increase its durability are coal-tar creosote, zinc chloride, and sodium fluoride.

Creosote is the best all-around preservative known and is particularly suitable for sills or timbers closed in by metal or other impervious covering, for it is a brown to blackish oily substance that would readily stain fabric. For other places a colorless water-soluble substance like zinc chloride or sodium flouride is preferable, the former being used in a 6 per cent concentration, the latter in a 3 per cent. Wood treated with either of the latter substances can be satisfactorily painted if necessary.

[3] Full information can be secured from the Forest Products Laboratory, Madison, Wisconsin, or from the American Wood Preservers' Association, Chicago, Illinois.

It is also claimed [4] that creosoted wood can be satisfactorily painted. The article cited states that "results thus far obtained indicate that the use of aluminum paint on creosoted wood is entirely satisfactory, providing the proper vehicle is used and the wood is first allowed to dry for a time after treatment." If this be the case the sole objection to the use of creosote on exposed parts of the automobile body would be overcome.

In replacement work preservatives could also be used to advantage in the Tropics. Most shops in Manila use untreated guijo (*Shorea guiso*) for general repair work. This is a moderately heavy to heavy wood, which is rather hard, tough, and difficult to split. It is moderately durable and is widely used in the Philippines for vehicle parts. Unfortunately, this wood is refractory to preservative treatment. Apitong (*Dipterocarpus* spp., officially *D. grandiflorus* Blco.) is another Philippine wood, however, that compares well in strength with American white oak and that readily absorbs either creosote or water-soluble preservatives, hence is widely used for treated ties, poles, posts, piling, etc. There is no reason why it cannot satisfactorily be used in place of guijo, with the added advantage, when properly treated, of being highly resistant to decay. There should be no necessity for replacing treated apitong during the life of the car. A proper treatment would be about 6 pounds of creosote per cubic foot (empty cell pressure process), or approximately 0.5 pound (dry salt) of zinc chloride or 0.25 pound of sodium fluoride.

As an alternative to this more-approved procedure, soaking the timber, after framing, for several hours in a wood or iron vat of the hot solution and then allowing it to cool in the same solution to atmospheric temperature would also give a high degree of protection, probably sufficient for the purpose in most cases. Such a nonpressure process merely requires a vat of suitable size fitted with steam coils to bring the temperature up to the desired point. If creosote is used it should be heated to about 180° C., while water solutions are brought to the boiling point and held there until the wood is heated to the center. If the vats are covered evaporation will not be excessive. The use of iron vats would simplify heating where steam is not available, since a fire beneath would accomplish the same purpose.

[4] Wood Preserving News 8 (Dec. 1930) 177. Published by the American Wood-Preservers' Association.

There is still another process in which the hot preservative is applied as a spray or is put on with a wire-bound paint brush. While this is hardly more than a make-shift it will increase the life of the timber to some extent, particularly if the ends of the timber, where joined, are allowed to absorb all the solution possible. This is better than no treatment at all, even with refractory wood such as guijo.

In Manila at the present time there is but one pressure treating plant,[5] handling principally large construction material. It is questionable, however, whether it would be feasible for the small repair man to have his comparatively small quantities of framed material treated on special order. Therefore, while we do not usually recommend the cutting and shaping of timber after treatment, it might be feasible, since apitong takes treatment so readily, to have the blanks cut out to approximate size, treated and held in stock either by retailers or by the plant. There would be some wastage in such a procedure, but the material cost in car-repair work is small compared to the labor cost.

Taking everything into consideration, however, the non-pressure vat treatment, while less reliable when not properly done, may be more convenient. If the treating equipment be located at or near the place where the repairs are being made it would be a simple matter to cut and fit the timbers for a job, drop them in the preservative vat for a few hours, then assemble them. Creosote-treated stock would not require more than a couple of days in the sun to dry the surface, but of course wood soaked in a water solution would require drying again to its original air-dry condition. Small pieces would season in a few days under cover during dry weather, but larger pieces would probably require rather too long a delay for economic operation. In consequence of this it would seem advisable to use creosote wherever possible.

[5] Atlantic, Gulf, and Pacific Company.

ILLUSTRATIONS

Plate 1

Fig. 1. Body of 1925 model closed car removed for repair of the wood frame. Note the severe decay in the sills and timbers joined to them.

2. Decay of the upper right corner in the top of the same car.

3. Decay of running board after two years service in Manila.

Plate 2

Fig. 1. Thoroughly rotted frame of 1926 model closed car after three years service in the Philippines. The timbers are so rotten that the frame fell apart at the joints when the metal covering was removed.

2. Front view of the same car.

3. Back left corner of the same.

4. View of back right corner and side of the same car.

5. Detail view of upper left corner at back (see fig. 3).

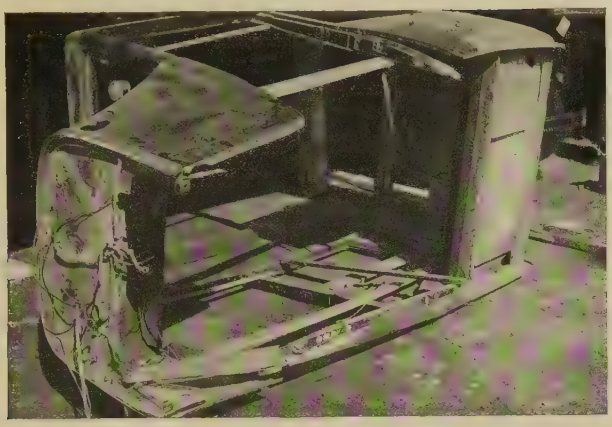
6. Left sill of same car.

7. Detail view of left corner (see fig. 3). Note fungous mycelium clinging to the horizontal piece.

8. Sills of a 1921 model car decayed at the ends.

9. Fruiting bodies of *Lenzites striata* on decayed wood taken from the frame of another closed car.

10. Sill from the car shown in Plate 1, fig. 1. The white coating consists of a thin layer of fungous mycelium.



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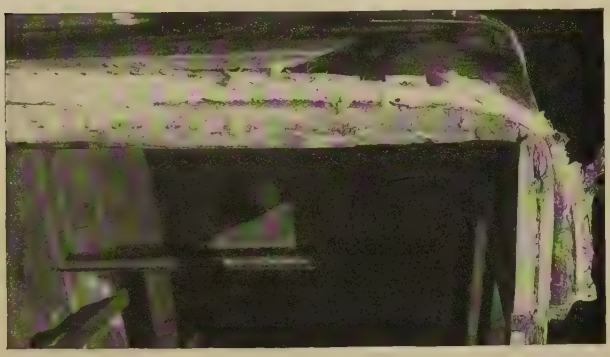

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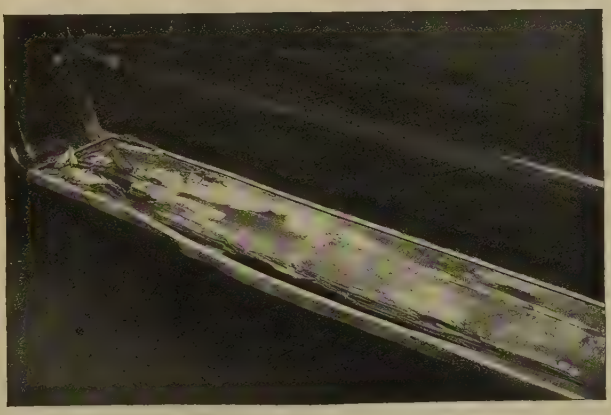

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PLATE 1.

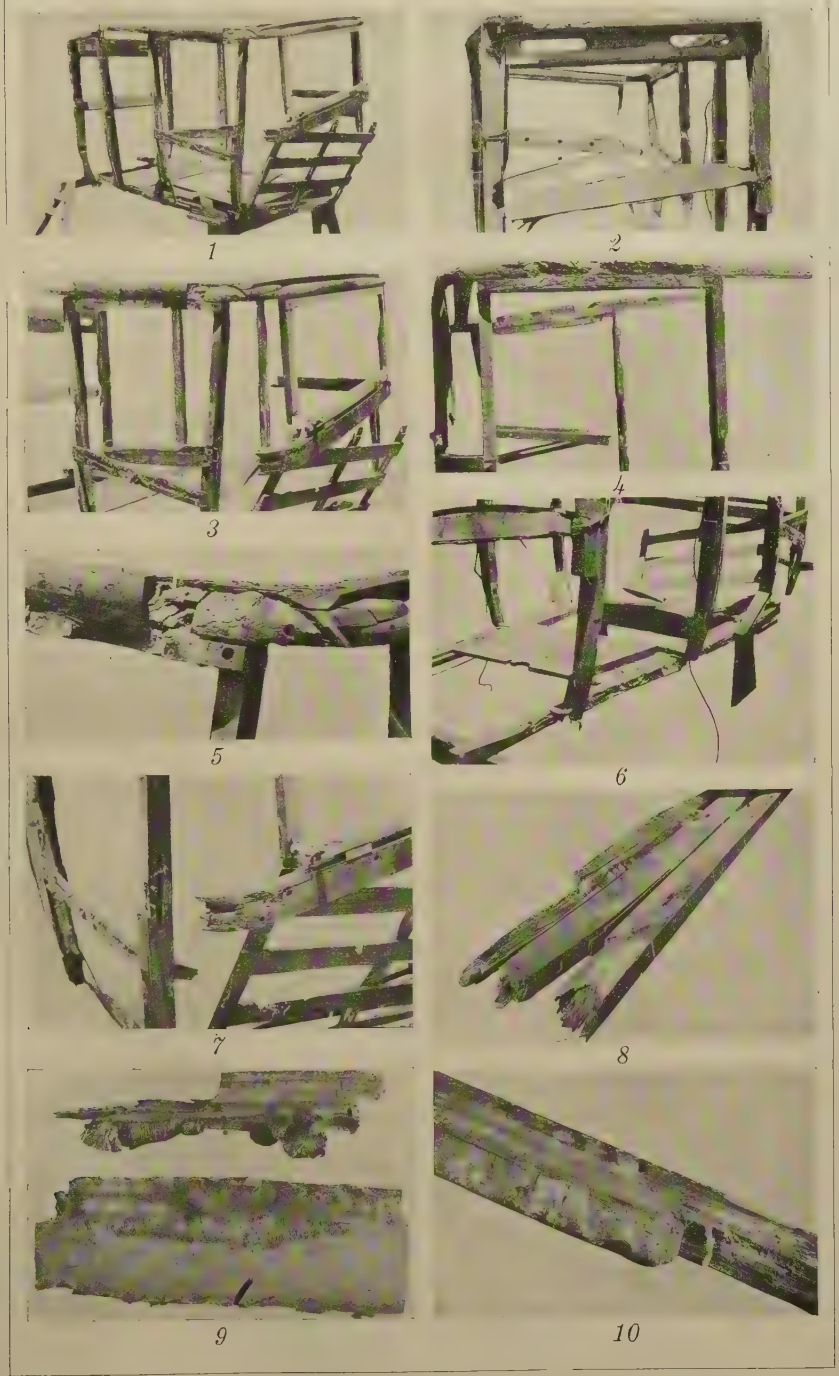

PLATE 2.

COMPOSITION OF PHILIPPINE PEANUT OIL

By Aurelio O. Cruz and Augustus P. West

Of the Bureau of Science, Manila

ONE PLATE

High-grade peanut oil serves as a salad oil and also for the manufacture of oleomargarine. The lower-grade oil is suitable for making soap. The oil cake from peanut oil serves as an excellent cattle food as it contains a very high percentage of proteins and is easily digested.[1]

Recently oil from Philippine peanuts was investigated in this laboratory and the results showed that the Philippine oil has a composition very similar to that of American peanut oil. It would seem that there are promising prospects for the development of peanut cultivation in the Philippines.

The composition of peanut oil has been the subject of a number of investigations as pointed out by Jamieson, Baughman, and Brauns [2] in their paper on the composition of oil obtained from the white Spanish type of peanuts grown in South Carolina and also the Virginia type grown in Virginia. Their results showed that the composition of the saturated acids obtained from the glycerides of these two oils is about the same though the Spanish type oil contains a slightly larger amount of saturated glycerides than the Virginia type.

Information concerning the commercial aspects of the peanut industry such as the picking and handling of peanuts, by-products from crushing peanuts, and peanut oil, flour, butter, candy, and cookies may be obtained from various Government publications.[3]

Recently there have appeared two articles [4] which give a very good resume of the present status of the peanut industry.

[1] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1922) 314.

[2] Journ. Am. Chem. Soc. 43 (1921) 1372.

[3] Beattie, W. R., U. S. Dept. Agr. Bur. Plant Ind. Cir. 88 (1911).
Reed, J. B., U. S. Dept. Agr. Bull. 1096 (1922).
Beattie, W. R., U. S. Dept. Agr. Bur. Plant Ind. Cir. 98 (1912).
Bailey, H. S., and J. A. Le Clerc, Yearbook U. S. Dept. Agr. (1917) 239.

[4] Lynch, D. F. J., Journ. Chem. Ed. 7 (1930) 794, 1037.

Peanuts are cultivated to some extent in the Philippines, but to supply the local demand considerable quantities are also imported.

During the year 1929, 1,632,960 kilograms of peanuts valued at 256,833 pesos and 1,870,107 kilograms of peanut oil valued at 570,435 pesos were imported into the Philippines.[5] Most of these supplies come from China. Peanuts can be grown very easily in the Philippines, both from cuttings and seeds, especially in rotation with rice, corn, and other short-maturing crops. Since there is a considerable demand for peanuts and peanut oil it would seem that their cultivation should offer excellent prospects as a Philippine industry.

EXPERIMENTAL PROCEDURE

The peanuts used in this investigation were very kindly supplied by Dr. Nemesio Mendiola, of the College of Agriculture, University of the Philippines. They were the kind of peanuts known locally as the Valencia variety. The shells were first removed from the nuts after which the kernels were heated in an oven (80° C.) for about an hour. As the heating expels most of the moisture, the brown seed coats can then be removed easily from the kernels. After removing the seed coats the kernels were ground to a pulp, which was then cold-pressed to obtain the peanut oil. The oil was filtered to eliminate most of the fiber. After successive treatments (warming, shaking, and filtering) with kieselguhr, suchar, and talcum powder, a sample of oil was obtained with only a slight yellow color and a very high degree of purity. The yield of oil, calculated on the shelled nuts, was about 40 per cent.

The constants of Philippine peanut oil are given in Table 1. There are also included for comparison the constants of Spanish and Virginia type peanuts as determined by Jamieson, Baughman, and Brauns.

Figures for the Philippine oil represent the average of closely agreeing duplicate determinations. As shown by the data (Table 1) the physical and chemical constants of the Philippine oil are quite similar to those of American oils.

The saturated and unsaturated acids that occur as glycerides in Philippine peanut oil were separated by the lead-salt-ether

[5] Annual Report, Insular Collector of Customs, Manila (1930).

TABLE 1.—*Physical and chemical constants of peanut oil.*

Constants.	Philippine oil from Valencia variety of peanuts.	American oil.[a]	
		Spanish-type peanuts.	Virginia-type peanuts.
Specific gravity	0.9077, $\frac{30°}{4°}$ C.	0.9148, $\frac{25°}{25°}$ C.	0.9136, $\frac{25°}{25°}$ C.
Refractive index	1.4676		
Iodine number	[b]101.8	90.1	94.8
Saponification value	191.5	188.2	187.8
Unsaponifiable matter, per cent	0.29	0.22	0.27
Acid value	0.10	0.12	0.03
Saturated acids, determined, per cent	[c]17.56	[d]21.4	[e]17.4
Unsaturated acids, determined, do	77.44	73.4	77.7
Saturated acids, corrected, do	17.12	20.6	16.4
Unsaturated acids, corrected, do	77.89	74.6	78.7
Iodine number of unsaturated acids, determined	125.0	121.8	118.2

[a] Analyzed by Jamieson, Baughman, and Brauns.
[b] Determined by Hanus method.
[c] Iodine number 3.1.
[d] Iodine number 4.8.
[e] Iodine number 7.1.

method [6] in accordance with the suggestions of Baughman and Jamieson.[7] The results are recorded in Table 2.

TABLE 2.—*Separation of saturated acids from the unsaturated acids in peanut oil by the lead-salt-ether method.*

Experiment No.	Oil used.	Unsaturated acids.	Saturated acids.	Unsaturated acids (determined).[a]	Saturated acids (determined).	Unsaturated acids (corrected).	Saturated acids (corrected).
	g.	*g.*	*g.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	9.5764	7.3966	1.7000	77.24	[b]17.75	77.68	17.31
2	9.6772	7.5143	1.6805	77.65	[c]17.37	78.09	16.93
Mean				77.44	17.56	77.89	17.12

[a] Unsaturated acids: Saponification value 202.3; iodine number (Hanus) 125.0.
[b] Iodine number (Hanus) 3.10.
[c] Iodine number (Hanus) 3.15.

The composition of the unsaturated acids separated from peanut oil by the lead-salt-ether method was determined by means of the bromoderivative method.[8] This consists in converting the unsaturated acids into their bromo-derivatives, which

[6] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.

[7] Cotton Oil Press 6 (1922) 41. Journ. Am. Chem. Soc. 42 (1920) 2398.

[8] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 585.

are then separated by suitable solvents. The laboratory data for duplicate analyses are given in Tables 3 and 4.

TABLE 3.—*Determination of unsaturated acids of peanut oil (bromo-derivative method). Analysis 1.*

	Grams.
Sample of unsaturated acids	3.1512
Linolic tetrabromide insoluble in petroleum ether, melting point 113–114° C.	1.2013
Residue (dibromide and tetrabromide); bromine content, 40.37 per cent	4.3385
Dibromide in residue, 75.57 per cent	3.2786
Tetrabromide in residue, 24.43 per cent	1.0599
Total tetrabromide found	2.2612
Linolic acid equivalent to tetrabromide	1.0552
Oleic acid equivalent to dibromide	2.0918

TABLE 4.—*Determination of unsaturated acids of peanut oil (bromo-derivative method). Analysis 2.*

	Grams.
Sample of unsaturated acids	3.2970
Linolic tetrabromide insoluble in petroleum ether, melting point 113–114° C.	1.4786
Residue (dibromide and tetrabromide); bromine content, 39.60 per cent	4.2577
Dibromide in residue, 80.06 per cent	3.4087
Tetrabromide in residue, 19.94 per cent	0.8490
Total tetrabromide found	2.3276
Linolic acid equivalent to tetrabromide	1.0862
Oleic acid equivalent to dibromide	2.1748

A summary of these duplicate analyses (Tables 3 and 4) is given in Table 5.

In Table 6 is given the composition of the mixed unsaturated acids of Philippine peanut oil. There are also included the calculated percentages of glycerides corresponding to these individual unsaturated acids.

Saturated acids.—The saturated acids were separated from Philippine peanut oil by the lead-salt-ether method and esterified with methyl alcohol. The mixed acids were dissolved in methyl alcohol and saturated with dry hydrogen chloride gas. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal

TABLE 5.—*Unsaturated acids of peanut oil; summary of analyses 1 and 2.*

Acid.	Analysis.		Mean.
	1	2	
	Per cent.	*Per cent.*	*Per cent.*
Linolic	33.49	32.95	33.22
Oleic	66.38	65.96	66.17
Total	99.87	98.91	99.39

TABLE 6.—*Unsaturated acids.*

Acid.	Mixture of unsaturated acids.		Glycerides in original oil.
	Composition.	Proportions in original oil.	
	Per cent.	*Per cent.*	*Per cent.*
Linolic	33.22	25.88	27.04
Oleic	66.17	51.54	53.86
Total	99.39	77.42	80.90

solution washed with sodium carbonate solution and afterwards with water. The ethereal solution was then dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters (83.29 grams), which were yellow, were distilled under diminished pressure. A preliminary distillation at about 3 millimeters pressure was made. The esters (83.14 grams) were then redistilled at 3 millimeters pressure. Data on the distillation of the esters are given in Tables 7 and 8.

TABLE 7.—*First distillation of the methyl esters of the saturated acids; pressure, 3 millimeters; 83.29 grams of esters distilled.*

Fraction.	Temperature.	Pressure.	Weight.
	°C.	*mm.*	*g.*
A	170–178	3	14.69
B	178–181	3	16.25
C	181–185	3	12.94
D	185–196	3	11.73
Residue	----------	----------	27.53
Total	----------	----------	83.14

TABLE 8.—*Second distillation of the methyl esters of the saturated acids; pressure, 3 millimeters; 83.14 grams of esters redistilled.*

Fraction.		Temperature.	Pressure.	Weight.
From first distillation.	Second distillation.			
		°C.	mm.	g.
A and B	1	170–173	3	17.15
C	2	173–176	3	15.54
Do	3	176–186	3	14.15
D	4	186–203	3	7.92
Residue	5	203–225	3	8.24
Do	6	225–230	3	6.02
Do	7	230–238	3	11.87
	Residue			1.99
Total				82.88

TABLE 9.—*Analyses of fractions obtained in the second distillation of the mixed methyl esters.*[a]

Fraction.	Iodine number.	Saponification value.	Mean molecular weight of mixed esters.	Composition of mixed esters.		Mean molecular weight of saturated esters.
				Saturated.	Unsaturated.	
				Per cent.	Per cent.	
1	2.5	207.1	270.9	97.90	2.10	270.4
2	4.5	203.7	275.4	96.22	3.78	274.9
3	12.4	199.0	281.9	89.58	10.42	280.9
4	16.3	189.4	296.2	86.30	13.70	297.0
5	9.5	177.1	316.8	92.02	7.98	319.2
6	3.2	165.3	339.4	97.31	2.69	341.0
7	1.4	156.6	358.2	98.82	1.18	359.2

[a] Calculated iodine number of unsaturated methyl esters was 119. Calculated saponification value of unsaturated methyl esters was 192.6.

TABLE 10.—*Saturated acids corresponding to methyl esters in each fraction.*

Fraction.	Acids.							
	Palmitic.		Stearic.		Arachidic.		Lignoceric.	
	Per cent.	g.	Per cent.	g.	Per cent.	g.	Per cent.	g.
1	92.83	15.92						
2	76.25	11.85	15.07	2.34				
3	52.78	7.47	32.32	4.57				
4	3.80	0.30	78.44	6.21				
5			22.24	1.83	65.74	5.42		
6					68.73	4.14	24.56	1.48
7					39.11	4.64	55.84	6.63
Residue [a]								1.92
Total		35.54		14.95		14.20		10.03

[a] Residue assumed to be methyl lignocerate.

In Table 9, are given the analyses of fractions obtained in the second distillation of methyl esters. From the data, Table 9, there were calculated the amounts of the individual acids corresponding to the methyl esters contained in the various fractions. The results are recorded in Table 10 and were calculated in accordance with the methods outlined by Baughman and Jamieson in their investigations of Hubbard squash-seed oil [9] and also American peanut oil.[10]

In Table 11, are given the composition of the mixed saturated acids and the glycerides in the original sample of peanut oil corresponding to these acids.

TABLE 11.—*Saturated acids.* [a]

Acid.	Mixture of saturated acids.			Glycerides in original oil.
	Weight.	Composition.	Proportions in original oil.	
	g.	*Per cent.*	*Per cent.*	*Per cent.*
Palmitic	35.54	47.57	8.14	8.54
Stearic	14.95	20.01	3.43	3.58
Arachidic	14.20	19.00	3.25	3.38
Lignoceric	10.03	13.42	2.30	2.38
Total	74.72	100.00	17.12	17.88

[a] When separated from peanut oil the corrected percentage of saturated acids was 17.12.

TABLE 12.—*Composition of peanut oil.*

Constituent.	Philippine peanuts (Valencia variety).	American peanuts.[a]	
		Spanish type.	Virginia type.
Glycerides of:			
Unsaturated acids—			
Oleic	53.9	52.9	60.6
Linolic	27.0	24.7	21.6
Saturated acids—			
Palmitic	8.5	8.2	6.3
Stearic	3.6	6.2	4.9
Arachidic	3.4	4.0	3.3
Lignoceric	2.4	3.1	2.6
Unsaponifiable matter	0.3	0.2	0.3
Total	99.1	99.3	99.6

[a] The composition of the American peanut oil was determined by Jamieson, Baughman, and Brauns, Journ. Am. Chem. Soc. 43 (1921) 1372.

[9] Journ. Am. Chem. Soc. 42 (1920) 156.
[10] Journ. Am. Chem. Soc. 43 (1921) 1372.

The composition of Philippine peanut oil is given in Table 12. There are also included for comparison the analyses of oil from the Spanish and Virginia types of peanuts.

The determined iodine number of Philippine peanut oil was found to be 101.3 and the determined saponification value 191.5. The calculated iodine number is 93.3 and the saponification value 188.4. The iodine and saponification values calculated from the composition of the oil agree fairly well with the determined values.

SUMMARY

The composition of Philippine peanut oil has been determined and the results (Table 12) indicate that the Philippine oil has a composition very similar to that of American peanut oil.

The percentage of linolic and palmitic glycerides is slightly higher in the Philippine oil than in the American oils while the percentage of the other glycerides is about the same or slightly lower.

Peanuts can be grown easily in the Philippines. Since Philippine peanuts yield an oil of high quality and about the same composition as American peanut oil, it would seem that there are promising prospects for the development of peanut cultivation in the Philippines.

ILLUSTRATION

PLATE 1. Peanuts growing at Agricultural College, Los Baños, Laguna Province, Luzon.

PLATE 1. PHILIPPINE PEANUT PLANTS.

NEW OR INTERESTING ORIENTAL FERNS

By Edwin Bingham Copeland

Of the Herbarium, University of California, Berkeley

LYCOPODIUM EDAÑOI Copel. sp. nov.

Phlegmaria laxa, caule deorsum fere 2 mm crasso, foliis ibidem tristichis remotis oblongis basi cuneatis, sursum gracile, foliis ovatis brevissime petiolatis 6 mm longis 3.5 mm latis, acutis haud acuminatis, basi rotundatis, coriaceis, viridibus; spicis infra furcam inferam sporophyllis lanceolato-ovatis subacuminatis plerisque alternantibus sporangias duplo superantibus aspersis, sursum sporophyllis triangulari-ovatis sporangias vix vel paullo superantibus acutis interdum imbricantibus; ramis foliosis 10-12 mm, spicis 1.5 mm latis.

Palawan, Mount Mantalingajan, *Bur. Sci. 77930 Edaño,* April, 1929.

Among Philippine species, this is nearest to *L. delbrueckii,* from which it differs in having ovate, instead of oblong, leaves, much more slender spikes with short sporophylls except at the base, and in the peculiar transition zone below the first dichotomy of the inflorescence. Among the more broadly construed species of the past, this might have been included in the *L. phlegmarioides* of Baker; hardly, however, in that of Gaudichaud, even if one ignores the description and figure of that species as having shoots bilaterally, not radially, symmetrical, with moderately dimorphous foliage leaves, as in *Diphasium.*

CYATHEA BONTOCENSIS Copel. sp. nov.

C. heterolobae affinis, trunco ignoto, stipite 20-25 cm longo, rhachique gracilibus supra basin paullo crassiorem 3-4 mm crassis, fulvis, minute asperulis, glabrescentibus; fronde 85 cm longa, 30 cm lata; pinnis infimis 6 cm longis, medialibus 20 cm longis, 5 cm latis, acuminatis, subsessilibus, rhachibus inferne praecipue deorsum paleis pallidis linearibus minute ciliatis 2-3 mm longis ornatis, apices versus paleis minoribus et pilis etiam albidis sparse vestitis; pinnulis sessilibus, usque ad 28 mm longis, 6 mm latis, obtusis vel acutis, apud basin paullo dilatatis et inciso-lobatis (infimis interdum ibidem pinnatis pin-

nula utroque latere una), alibi obscure serrulatis, costa inferne deorsum squamulis minutis fulvis, sursum pilis ornata, lamina glabra papyracea; venulis ca. 10-paribus, plerisque pinnatis; soris inframedialibus, magnis, indusio brunneo, mox fisso, persistente.

LUZON, Bontoc Subprovince, *Vanoverbergh 813*, November–December, 1910.

Nearly related to *C. heteroloba*, from which it is distinguished by more slender and naked stipe and rachis, narrower and less crowded pinules, and the presence of elongate paleæ on the minor rachises and of hairs on the costæ. The two form an isolated group.

CYATHEA CALOCOMA (Christ.) Copel.

A specimen collected by *Fenix, Bur. Sci. 12711*, at Sablong, Benguet, is essentially identical with those from Mindoro. This range would be commonplace in most genera, but is notable in *Cyathea*. Possibly this species is more common than is supposed, being unrecognized unless the base of the stipe is present.

CYATHEA CONTAMINANS (Wall.) Copel.

This is the commonest and largest of the Oriental tree-ferns, the least exigent as to habitat, and the only species evidently able to thrive in open places at moderate altitudes. It varies much in ampleness, which may be due entirely to environmental conditions. The largest specimens have just been brought in by Ramos, *Bur. Sci. 77170*, from Cagayan Province. The pinna is more than a meter long; the pinnules 15 cm, and the segments 4 mm wide, almost entire, and obtuse or only subacute. In the other direction, several collections run below the size typical of *C. clementis*.

Two large specimens collected by Ramos in 1912, in Camiguin de Misamis, a small volcanic island north of Mindanao, are remarkable in other respects. *No. 14872* has the pinna 95 cm long, pinnules 17 cm long and 3 cm wide, and falcate, acute segments, the sterile ones 4 mm wide, the fertile ones only 2.5 mm wide and separated by much more than their own width. *No. 14841* has pinnules 15 cm long and up to 4 cm wide, the fertile segments likewise narrow if merely serrate but more closely placed and, therefore, more numerous; but many of these segments are dilated by the elongation of the teeth, to a width of 5 mm, with the margin then fairly laciniate. The rachis of the pinna is pale-tawny; of the pinnule, dark-chestnut.

CYATHEA DUPAXENSIS Copel. sp. nov.

Trunco ignoto; stipite 30 cm longo, 1 cm crasso, atropurpureo, spinis vix 1 mm longis multis horrido, deorsum superne paleis atrocastaneis angustissimis 1-2 cm longis sparse vestito; rhachi deorsum castanea sursum fulva, glabra, inerme; pinnis infimis valde reductis, medialibus 45-50 cm longis, 14-15 cm latis, subsessilibus, acuminatis, rhachibus fulvis mox glabris sparsissime muriculatis; pinnulis maximis 3 cm longis (infimis paullo minoribus), 12 mm latis, subsessilibus, caudato-acuminatis cauda argute serrata, etiam ad basin vix pinnatis, costa inferne subglabra hinc inde squamulis minutis adspersa; segmentis obliquis, contiguis 6-7 mm longis, 3 mm latis, oblique subacutis; obscure serrulatis, pallide viridibus, papyraceis, ad costas inter soros sparse squamuliferis alibi glabris; venis 7-8 paribus, inconspicuis; soris stricte costularibus, 0.6 mm latis, exindusiatis vel squamulis subtensis.

LUZON, Nueva Vizcaya Province, Dupax, *Bur. Sci. 14391, McGregor*, March–April, 1912.

Distinguished from *C. callosa* by the absence of a developed indusium; from *C. caudata* by smaller, thinner frond, more densely spiny and less scaly base of stipe, and smaller sori. *Cyathea callosa* and *C. caudata* are doubtfully different.

CYATHEA EDAŞOI Copel. sp. nov.

C. melanophlebiæ affinis, minor, trunco 1-2 m alto, 10-15 cm crasso; stipite brevissimo, 1 cm crasso, rhachique atrocastaneis, muricatis spinis 0.5 mm longis sursum minoribus sparsis, deorsum paleis linearibus castaneis 6 mm longis squamulisque amorphis appressis sparse vestitis sursum glabrescentibus; fronde ovata, 45 cm lata, utrinque angustata, subtripinnata; pinnis infimis 5 cm longis haud remotis, infimis fructiferis 10 cm longis, medialibus 30 cm longis 11 cm latis, brevisti-pitulatis, rhachibus inferne fuscis glabris vel primo ad insertiones pinnularum parce paleatis; pinnulis infimis reductis, medialibus 6 cm longis 18 mm latis, subsessilibus, breviacuminatis, costis inferne nudis obscuris; segmentis infimis interse liberis (pinnulis secundariis) plerumque adnatis, sequentibus ala angusta confluentibus, 2.5-3 mm latis, obtusis, obscure crenulatis, nudis papyraceis, superne nigro-viridibus inferne olivaceis; venulis ca. 8-paribus; soris costularibus, magnis, indusio praecipue marginem versus aperto, denum persistente.

LUZON, Cagayan Province, summit of Mount Cagua, altitude

1,300 meters, *Bur. Sci. 78709 (type), and 78700 Edaño,* October–November, 1929.

This differs from *C. melanophlebia* Copel.,[1] as both species are known, in having decidedly smaller fronds, smaller spines but rougher rachis, and in being still more free of paleæ on any part of the frond; possibly it is a reduced mountain-top form. Another nearly related species is *C. halconensis.* The oldest species in the general group is *C. caudata.*

CYATHEA MERRILLII Copel. sp. nov.

Pseudohemitelia, trunco ignoto; stipite valido, atropurpureo, spinoso spinis 2 mm longis minute castaneo-furfuraceo; rhachi inerme, fusco-fulva, inferne glabra; pinna mediale 50-55 cm longa, 18 cm lata, subsessile, rhachi fulva, glabra, sparsissime muriculata; pinnulis medialibus 10 cm longis (infimis paullo minoribus), 16 mm latis, caudato-acuminatis, subsessilibus, ad basin pinnatis pinnulis ᵘ adnatis, alibi fere ad costam pinnatifidis, costa inferne squamulis minutis plerisque angustis sparsis vestita; segmentis haud contiguis, 10 mm longis, 2-3 mm latis, acutis, integris, tenuiter papyraceis, superne obscure, inferne laete viridibus, costis inferne squamulis minutis fulvis plerisque ovatis vestitis; venis 10-11-paribus, quarum ca. 8-paribus apud costam furcatis et ibidem soriferis; soris vix 0.5 mm latis, indusio ad squamam unilateralem basalem reducto.

LUZON, Benguet Subprovince, *Merrill 7819,* May, 1911.

Probably related to *C. mearnsii* of the same region, but thinner, with more entire segments, and clearly distinguished by the reduction of the indusium to a basal scale.

CYATHEA PUSTULOSA (Christ.) Copeland.

Cyathea pustulosa (Christ.) COPELAND, Philip. Journ. Sci. § C 4 (1909) 51.

BABUYAN, Camiguin Volcano, *Bur. Sci. 79615 Edaño,* March, 1930. Previously reported from Oshima and Formosa; new to the Philippines.

CYATHEA SQUAMICOSTA Copel. sp. nov.

Rhachi valida, fulva, minutissime asperula setis minutis obsita et tuberculis parvis paucis sparsa; pinna mediale sessile, 50-55 cm longa, 17 cm lata, abrupte in apicem lanceolatam pinnatam contracta, bipinnata, costa paleis fulvis sordidis lanceolatis 2 mm longis et ovatis vix 1 mm longis vestita, demum glabrescente, muriculata; pinnulis maximis 9 cm longis, acu-

[1] Philip. Journ. Sci. 38 (1929) 131.

minatis, sessilibus, basi 22 mm latis, ibidem pinnatis pinnulis [11] sessilibus, alibi fere ad costam pinnatifidis, costa inferne paleis descriptis hic persistentibus vestita; segmentis contiguis vel imbricatis, 3 mm latis, subfalcatis, apice rotundatis, integris, coriaceis, olivaceis, costis deorsum squamuliferis, aliter glabris; venis ca. 10-paribus, immersis et inconspicuis; soris costularibus, parvis; indusio mox in cupulam brevem reducto.

LUZON, Benguet Subprovince, Mount Pauai, *Bur. Sci. 8326 McGregor,* June, 1909, altitude 2,100 meters.

This species is well marked by the minute roughness of the rachis, the chaffiness, the very closely placed segments with rounded apices, and the small, costular sori. It is from a much-visited locality, and has been held twenty years for description, in the hope that more complete material with younger sori would be collected.

DRYOPTERIS CLEMENSIAE Copel. sp. nov.

D. gregis D. canescentis indusiis persistentibus, rhizomate repente, lignoso, 2 mm crasso, paleis paucis parvis atrocastaneis vestito, glabrescente; stipitibus approximatis 8-15 cm longis, versus basin squamulis paucis deciduis praeditis, alibi rhachibusque setis fulvis curvatis vix 1 mm longis, dense vestitis; fronde 10-15 cm longa, 4-5 cm lata, basi truncata, acuminata, segmento apicale deltoidea pinnatifida, alibi pinnata, atroviride, subcoriacea; pinnis utroque latere ca. 5, oppositis, sessilibus, lanceolato-ovatis, infimis haud reductis sed subdeflexis et basi plus minus angustatis, aliis basi cuneato-truncatis, acutis apice subfalcatis, serrato-lobatis, costis venisque minute pubescentibus; venatione irregulare, venulis extra seriem unam areolarum costalium plerisque liberis; soris sparsis ad venulas aut dorsalibus aut ad anastomonoses impositis, indusiis parvis, nudis, orbiculari-reniformibus.

LUZON, Isabela Province, Mount Moises, *M. S. Clemens 16490,* April, 1926. Type in *Herb. Univ. Calif. 285486.*

The irregular venation is suggestive of *D. otaria,* to which, however, there is no near affinity.

DRYOPTERIS PARASITICA (L.) O. K.

LUZON, Cagayan Province, Pagikpik, *Bur. Sci. 79644 Edaño,* on slopes in forest, altitude 1,000 feet.

Ferns bearing this name, or such predecessor-names as *Nephrodium molle,* are well known in Philippine collections, but this is the first known to me that fairly represents the species as now construed. It is identical with several Formosan collec-

tions, and like enough to those of southern China. The sori are a single pair at the bases of most segments, a second pair on some.

ATHYRIUM OPHIODONTUM Copel. sp. nov.

Diplazium caudice ignoto; stipite alto, 1 cm crasso, basi atrocastaneo paleis castaneis 2 cm longis basi 1 mm latis alibi angustissimis remote et minute spinoso-dentatis membranaceis contortis et intricatis vestito, sursum laete castaneo glabro, nullibi muricato; fronde magna, tripinnatifida, apice acuminata pinnatifida; pinnis medialibus 60 cm longis, 20 cm latis, caudato-acuminatis, stipitulis 5 cm longis protensis, rhachi potius sub lente quam sub digite muriculatis; pinnulis infimis quam sequentibus minoribus longiusque (5 mm) stipitulatis, medialibus usque et 11 cm longis, acuminatissimis, basi 3 cm latis, profunde pinnati fidis sinubus rotundatis integris angustis, costa inferne paleis paucis minutis vestita superne angustissime alata, ala ad basin venae quaeque interrupta et in dentem parvum protracta; segmentis oblongis, medialibus 10 mm longis, 3 mm latis, plerisque abrupte subfalcatis, tenuiter herbaceis, glabris, inciso-serratis dentibus approximatis acutissimis rectis vel inflexis; venulis hic simplicibus ca. 10-paribus (in pinnulis et segmentis inferioribus saepe furcatis et in dentes fissos protractis); soris costularibus, brevibus demum confluentibus, indusio angusto, pallido.

LUZON, Cagayan Province, Peñablanca, *Bur. Sci. 77188 Ramos*, May 12, 1929 "in forest streams, at low altitude." Type in Herbarium Bureau of Science.

This has the form and dissection of *A. blumei*, but the texture of the *A. umbrosum* group. *Athyrium costulisorum* and *A. tenuifolium* are Philippine species of similar size and texture; the former is fully tripinnate and the latter has muricate axes. The narrow, crinkly, brown (not black) paleæ and the very narrow and sharp teeth distinguish *A. ophiodontum* from all its relatives.

ASPLENIUM FINLAYSONIANUM Wall.

Our specimen is *A. macrophyllum* Sw. Christensen construes the name as having that application; and, likewise, seems certainly correct in construing *A. integerrimum* Hooker and Greville, Icones Filicum, Table 136, as the same species, in spite of Hooker's own testimony, Icones Plantarum, Plate 937, that it was an inaccurate presentation of the fern there (plate 937) described as *A. finlaysonianum* Wall. The latter is based on *Wallich 2682*, named *A. hookerianum* Wall. in the List—ac-

cording to our copy and according to Christensen, Index, page 115. Although both Hooker, loc. cit., Plate 937, and Mettenius, Asplenium, No. 149, cite *Wallich 2682* as the type or basis of *A. finlaysonianum* Wall., I mistrust their accuracy. It seems to me that the proper name or citation for their plant, instead of *A. finlaysonianum* Wall., or *A. finlaysonianum* Wall.; Hooker, as in Christensen's Index, is *A. finlaysonianum* Hooker, non Wallich.

The question then arises, could Hooker take Wallich's name, nomen nudum though it was, and, ascribing it to Wallich, give it valid application to a different plant? Or did Wallich's typification go with his specific name? If the latter is the case, the *A. finlaysonianum* of Hooker has no valid name. In his Species Filicum III, 272, published sixteen years after the plate in his Icones, Hooker's first citation is *Wallich 191,* from Penang and neighboring islands, as in the List, and his citation of *No. 2682* is explicitly indirect. One might readily assume that *No. 191* was a mixture, if it were not that all other published localities (and all of our specimens) are Himalayan.

ASPLENIUM TRIPINNATIFIDUM Copel. sp. nov.

Darea, ut videtur A. flaccido affinis, caudice ignoto, stipite longa rhachique straminee-viridibus superne profunde sulcatis paleis minutis lanceolatis sparsis; fronde 75 cm longa, 25 cm lata, acuminata, pallida, coriacea, inferne squamulis ovatis 0.4-0.7 mm longis ovatis clathratis castaneis sparsa tripinnatifida; pinnis infimis 8 cm longis, ovatis, medialibus 13 cm longis, 4.5 cm latis, valde caudatis, basibus stipitulatis oblique dilatatis, ad rhacheos applanatas vel anguste et crasse alatas pinnatis; pinnulis inferioribus 3.5 cm longis, 5 mm latis, oblique pinnatifidis, sequentibus (plerisque) linearibus incisis vel serratis, segmentis, resp. dentibus, 1 mm latis, acutis; venis omnino occultis; soris paucis, 2-3 mm longis, indusio 1 mm lato, persistente, ad marginem non attingente.

LUZON, Rizal Province, *Loher 14379,* April, 1913. Type in *Herb. Univ. Calif. 243202,* distributed from the herbarium Bureau of Science, Manila, as *Tapeinidium pinnatum.*

The texture, color, dissection, and squamules mark this as a member of the chiefly Austral group of *A. flaccidum* and *A. bulbiferum.* Taken in a broader sense the same group is represented by the widespread and common *A. tenerum.* It must be construed still more broadly to make it include *A. bullatum* Wall.; Mett., which has glabrous fronds of different texture and is very far from identical with *A. bulbiferum.*

STENOCHLAENA SMITHII (Fée) Underwood.

Lomariopsis smithii FÉE, Acrostichum, p. 71, pl. 33 f. 2 and 53.

We have perfectly typical material of this species from Cagayan Province, collected by Ramos in 1912, *Bur. Sci. 13887.* Because it occurs here in typical form, I believe that it is represented also by *Bur. Sci. 79645,* collected by Edaño at Pagikpik in the same province in 1930. This has the fertile pinna (only one is present) nearly as broad as in typical *S. smithii,* but the sterile pinnæ quite like those of *S. leptocarpa.* The rachis of the sterile frond is curiously wing-flattened toward the apex. This mixture of characteristics makes me suspect the distinctness of *S. smithii* and *S. leptocarpa,* neither of which is represented in herbaria by enough material to establish its uniformity. Of the two names, *S. leptocarpa* has priority, due to the apparent accident that Fée placed it in his section with "frondibus homomorphis," although describing them as dimorphous.

LINDSAYA LONGA Copel. sp. nov.

L. gregis L. macraeanae, pinnulis profundius incisis, lamina basiscopica imperfecte abscissa; rhizomate scandente, 2 mm crasso, paleis late lanceolatis castaneis vestito; stipitibus alternantibus castaneis, paleis paucis parvis ornatis, ca. 2 cm longis; fronde ca. 40 cm longa, 2.5-3 cm lata, utrinque attenuata, membranacea, rhachi straminea; pinnis plerisque imbricatis, basi acroscopice dilatatis, supra rhachin imbricatis, ibidem 6-7 mm latis, deinde usque ad apicem plerumque acutam angustatis, margine acroscopica prope basin ¼ ad costam, apicem versus profundius incisa, lamina basiscopica excisa, cum lobis infra apicem costam recipientam solitariis vel rarius nullis vel duo; venulis in lobo quoque aut solitariis aut duo in soro anastomosantibus, alibi liberis; soris fere marginalibus, lunulatis basi recurvatis, leviter si simplicibus, insigniter si venulas duas recipientibus.

PALAWAN, Mount Balagbag, *Bur. Sci. 77978 Edaño,* May, 1929.

The fronds are among the longest and narrowest in the group. The pinnæ are moderately protracted, less so than those of *L. apoensis* and *L. protracta,* the other species having pinnæ of the same general form. The affinity to these long-stipitate species is not as close as to the wide-spread *L. macraeana* and the Philippine *L. merrillii,* from both of which *L. longa* is distinguished by the form and deeper incision of the pinnæ and the form and position of the sorus. It is quite distinct from

L. fissa, likewise endemic in Palawan, which has more deeply cut pinnæ with truncate lobes, and sori not at all lunulate.

PHILIPPINE OLEANDRA

Pedicel short and stout, less than 5 mm long and shorter than stipe.
  Frond ciliate, pubescent.
    Frond acute at base ..... *O. mollis.*
    Base abruptly contracted ..... *O. benguetensis.*
  Frond not ciliate, glabrous or sparingly hairy..... *O. neriiformis.*
Pedicel short, but stripe almost wanting..... *O. colubrina.*
Pedicel commonly more than 5 mm long.
  Frond sessile on the pedicel..... *O. maquilingensis.*
  Frond stipitate.
    Costa bearing long paleae..... *O. whitneii.*
    Costa not conspicuously paleate.
      Fronds firm, 30 cm or more long.
        Sori 1 mm wide ..... *O. cumingii.*
        Sori about 2 mm wide..... *O. macrocarpa.*
      Fronds smaller ..... *O. scandens.*

OLEANDRA BENGUETENSIS Copel. sp. nov.

Rhizomate rampante, 4-5 mm crasso, radices graciles indivisas praelongas emittente, paleis 6-8 mm longis lineari-lanceolatis integris vel subciliatis appressis nigrescentibus dense obtecto; pedicello 2-3 mm alto, valido, sparse paleaceo; stipite ca. 10 mm alto, costaque minute pubescentibus et sparsissime paleaceis; fronde anguste lanceolata, ca. 25 cm longa, 2-2.5 cm lata, acuminata, basim versus angustata basi ima truncata, margine angustissime cartilaginea minute ciliata, utraque facie sparse puberula, papyracea; soris 2-6 mm a costa irregulariter seriatis; indusio semiorbiculare sinu latissimo.

LUZON, Benguet Subprovince, Baguio, *Elmer* (*Bureau of Government Laboratories*) *6286,* May, 1904. Type in *Herb. Copeland 8225. Williams 1510,* also from Baguio, September 24, 1904, probably represents the same species, but has a shorter stipe, more paleaceous stipe and costa, and the sori closer to the costa and in more regular lines.

Distinguished from *O. scandens* by much stouter stems, with supporting roots, shorter pedicel and stipe, longer, narrower, less pubescent fronds, and indusia of different shape.

I have been abstaining from the publication of these (and other) species of *Oleandra,* partly while I awaited publication on *Oleandra* from Professor V. Goebel's laboratory, partly in the hope of learning what real *O. neriiformis* is. As I now recognize them, the published Philippine species are distinguishable by the above key, in which two or more species each are included in *O. neriiformis* and *O. colubrina.*

OLEANDRA SCANDENS Copel. sp. nov.

Rhizomate repente, 2-3 mm crasso, radices graciles enim filiformes ramosas multas emittente, ubique paleis persistentibus castaneis lineari-lanceolatis 5 mm longis integris vel sparse et irregulariter ciliatis supra basin peltatis dense vestito; pedicellis remotis vel subaggregatis, gracilibus, 10-20 mm altis; stipite plerumque quam pedicello longiore, costaque pubescentibus; fronde lanceolata, 10-20 cm longa, 25-30 mm lata, acuta, basi frondium minorum plerumque rotundata, majorum saepius acuta, breviter ciliata, utraque facie pubescente, herbacea vel subcoriacea; soris in lineam irregularem 2-5 mm a costa remotam instructis; indusio fere orbiculare versus costam sinu breve angust affixo.

LUZON, Benguet Subprovince, Baguio, *Elmer* (*Bureau of Government Laboratories*) *6513*, June, 1904. Type in *Herb. Copeland 8219; Williams 1509*, ibidem, August 1904; also from Benguet, *Copeland 1804, Bur. Sci. 2778 Mearns, For. Bur. 15950 Bacani.* PALAWAN, Silanga, *Merrill 9850.* While varying in size, base, length of stipe and pedicel, and remoteness of sori from the costa, these belong clearly to one species, well marked by its pubescence, shape of indusium, and by fairly long pedicel and stipe. I have chosen as the type of collection the one probably most widely distributed to herbaria.

This has been distributed as *O. cumingii* Presl, a species described with "frons fere sesquipedalis, coriacea," no mention of ciliate border, which is too conspicuous and characteristic easily to be overlooked, pubescence on the veins; *O. scandens* is persistently pubescent on lamina and veins.

Oleandra cumingii was based on *Cuming 60 partim*, as was also *O. macrocarpa* Presl. My specimen of this collection (sterile) can hardly be either of them, having a pedicel hardly 2 mm long. It is very hairy on surfaces and margin, and not at all coriaceous. An imperfect specimen in the herbarium University of California conforms perfectly to the diagnosis. To *O. cumingii* has been reduced *O. chinensis* Hance, described as *valde coriacea.*

GRAMMITIS LIMAPES Copel. sp. nov.

Species G. pubinerviae et G. (Polypodio) bulbotrichae affinis rubustior; rhizomate repente vel suberecto, 1.5-2 mm crasso, paleis ferrugineis ovatis 1-2 mm longis vestito; stipitibus approximatis, basi articulatis, 5-7 cm altis, 1 mm crassis, pilis 1 mm longis atropurpureis debilibus vestitis et ob baseos bulbo-

sas pilorum omnino horridis; fronde vulgo 15, rarius usque ad 30 cm alta, maxima 9 mm lata, utrinque sed ad basim imam abrupte angustata, integra, inferne praecipue ad costam deorsum setis minutis sparsissimis deciduis vestita aliter glabra, rigide coriacea, costa valida inferne prominente nigra; venis furcatis et, ubi satis lata frons, ramo basiscopico item furcato, ramo acroscopico breve; soris medialibus vel costæ paullo propioribus, fere superficialibus, 2 mm latis, 2-3 mm longis haud confluentibus, sporangiis setis nigris brevibus obsitis.

JAVA, Gedeh, Panggrango, *Copeland,* May, 1915 altitude 2,800 meters.

This differs from Gedeh specimens identified as *G. pubinervia* in being decidedly stouter and more rigid, with larger sori, as well as in the peculiarity of the stipes, exceedingly rough to the eye and to the touch. *Grammitis pubinervia* and *G. congener,* as I construe them, have ordinary hairs on the stipe, stiffer and rather longer than those of *G. limapes,* but without enlarged bases. The Philippine *G. bulbotricha, Polypodium bulbotrichum* Copel., Philip. Journ. Sci. 40 (1929) 309, is likewise less robust and with smaller, as well as more costal, sori.

GRAMMITIS MULTIFOLIA Copel. sp. nov.

Species jamdiu confusa G. pusillae Blume (Polypodio hirtello) affinis frondibus longe stipitatis distincta; caudice breve, erecto, parvo, basibus longe stipitatis distincta; caudice breve, erecto, parvo, basibus stipitum radicumque occulto, paleis etiam occultis lanceolato ovatis castaneis integris acutis vix 1 mm longis vestito; stipitibus confertissimis, filiformibus, fuscis, 2-3 cm longis, pilis atropurpureis usque ad 2.2 mm (plerisque ca. 1.2 mm) longis ornatis; fronde lineare, vulgo 6 cm rarius usque ad 9 cm longa, 4 mm lata, obtusa, deorsum sensim angustata, integra vel subintegra, praecipue inferne sparse setosa, subcoriacea, costa gracile inferne prominente; venis immersis, furcatis, ramo acroscopico vix basiscopico aequente et deorsum sorifero; soris parvis, superficialibus, fere orbicularibus, subcostalibus, sporangiis interdum setiferis.

JAVA, Mount Panggrango, *Copeland,* May, 1915 altitude 2,700 meters; ibidem, *Miller,* 1897.

I believe this to be *Polypodium alpestre* Blume non Spenn., subsequently regarded by Blume as a variety of his *Grammitis pusilla,* but ill depicted in Flora Javae II, Pl. 46, f. 5, which shows fronds too broad and too hairy. It differs from the typical form of that species in having long stipes, relatively nar-

rower and firmer fronds and comparatively remote sori. It seems to me decidedly more distinct than Blume's var. *β lasiosora,* construed as a species by Fée (*Grammitis nana*) and Hooker.

GRAMMITIS STENOCRYPTA Copel. sp. nov.

G. fasciatae similis, paleis angustis et soris elongatis profunde immersis costa remotis facile distinguenda, rhizomate brevirepente, 1.5 mm crasso, paleis ferrugineis 4 mm longis, 1 mm latis dense vestito; stipitibus approximatis, 6-7 cm longis, 0.6-0.7 mm crassis, pilis paucis debilibus deciduis aspersis, basi nigro bulbosa paleis rhizomatis immersa articulatis; fronde lineare, 20 cm longa, 7-8 mm lata, utrinque attenuata sed apice ipsa obtusiuscula, integra, coriacea, inferne preaecipue ad costam pilis obscuris vix 1 mm longis mox omnibus caducis vestita deinde glabra; costa manifesta vix prominente; venis plerisque furcatis, ramo inferiore rarius iterum furcato, ramis in hydathodis inconspicuis terminantibus; soris inframedialibus, prima apparitione in cryptis 2.5-3, rarius usque ad 4, mm longis linearibus immersis, deinde sporangiis evolutis ellipticis oblique positis, sporangiis setis brevibus protectis.

JAVA, Gedeh, prope Kandang Badak, *Copeland,* May, 1915.

At first sight, much like *G. fasciata,* and perhaps in the past confused with that species. Too naked for confusion with *G. setosa* or *G. pubinervia,* longer stalked with longer sori, farther from the costa. *Grammitis longa* Fée can hardly be *G. fasciata,* as it has been construed, because *G. fasciata* is remarkable for its naked fronds and sporangia. The description of *G. longa,* 6th Mémoire, page 6, Plate 4, f. 1., is far inferior to its author's usual standard; it appears to differ from *G. stenocrypta* by having short stipes, more divergent and mostly twice forked sterile veinlets and the sori shorter, more costal, and more nearly parallel to the costa.

CAMPIUM SUBSIMPLEX (Fée) Copel.

Acrostichum zollingeri KZE., Bot. Zeit. 4 (1846) 419.

The suspicion that these are identical, expressed in Philip. Journ. Sci. 37 (1928) 357, can now be confirmed, as the California Herbarium has come into possession of a sheet of *Zollinger 1293.* Among the names borne by this sheet is *Leptochilus lanceolatus.*

EFFORTS TOWARD BIOLOGICAL CONTROL OF THE COMMON PINK MEALYBUG TRIONYMUS SACCHARI (COCKERELL) OF SUGAR CANE ON NEGROS

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While the pink mealybug of cane is not of as much importance on Negros as it is on Luzon, still it is of sufficient importance to warrant attempts at more complete control. The insect is numerous at present, perhaps due to the unusually dry rainy season just experienced on Negros. The effect of the dry period is to inhibit the growth of the entomophagous fungus *Aspergillus* sp., which is of considerable importance in the natural control of the mealybug. The damage caused by mealybugs is occasioned by the fact that they extract the cane sap and reduce purities.

In order to try to decrease the number of mealybugs now in evidence and to try to provide insurance against any possible future outbreak of the pest, two kinds of natural enemies (from Laguna, Luzon) have been liberated in parts of Negros by the Entomology Department, Philippine Sugar Association.

One of the insects is *Scymnus* sp.[1] (order Coleoptera, family Coccinellidæ) a small brown lady-bird beetle measuring 1.5 millimeters in length. The fully grown larvæ are only 3 millimeters in length, their small size enabling them to get down between the leaf-sheath and stalk where the mealybug is most commonly found. They devour the young mealybugs, and are thus predators.

[1] According to a recent letter from Mr. Swezey this coccinellid is a species of the genus Pullus.

The senior author believes that he is the first to discover the *Scymnus* and its importance. The life history is completed in about a month.

The second natural enemy is a small wasp, *Anagyrus* sp. (order Hymenoptera, family Encyrtidæ), determined by Mr. O. H. Swezey, entomologist of the Hawaiian Sugar Planters' Association Experiment Station, from specimens sent to him. In Hawaii there is another species of encyrtid that perfectly controls the gray sugar-cane mealybug, but never attacks the pink mealybug. It is very difficult to find gray mealybugs in Hawaii to-day, but at one time they were so numerous that they were considered destructive. This control was effected only after the encyrtid became established in Hawaii. Efforts are now being made to establish this new species of *Anagyrus* in Hawaii and it is hoped that it will do as good work on the pink mealybug as the other encyrtid does on the gray mealybug.

This family of wasps lives as parasites of the ova, larvæ, or pupæ of various insects. In the present case, its eggs are laid in nearly mature or mature mealybugs, the larvæ probably devouring the entire body contents. The length of the female wasp, which is yellowish, is about 1 millimeter. The males, which are black, are noticeably smaller. The life history of the Philippine *Anagyrus* is from twelve to sixteen days depending on the temperature. This wasp was first reared at the College of Agriculture by one of the entomology students.

The senior author, temporarily stationed at the College of Agriculture making studies of mealybug natural enemies for the Hawaiian Sugar Planters' Association Experiment Station, devised methods of rearing the two species above mentioned. He advised the junior author of these methods and supplied him with a supply for establishment on Negros.

Starting with a small nucleus, Mr. F. P. Goseco, assistant entomologist, Philippine Sugar Association, has been able to rear large numbers of both kinds of natural enemies in the laboratory. They are reared in cloth-covered battery jars and are supplied with mealybugs as needed.

Up to December 23, 1930, colonies ranging in number from forty to one hundred individuals of each species have been liberated at the La Carlota Central Experiment Station field; at the Ma-ao Central parent field; at Hacienda San Jose, of Ramon Yusay, Binalbagan Estate; at Hacienda Panaquiao of Emilio Montilla, Isabela Sugar Company; at Hacienda Tarog of Ilde-

fonso Doronila, Santos-Lopez Central, Panay; at the Hawaiian-Philippine Company experimental field; and at the experimental field of the Bacolod-Murcia Milling Company.

Fields are selected in which mealybugs are plentiful, and which will not be harvested before January, 1931, thus allowing the natural enemies sufficient time to become established.

Stocks are maintained in the laboratory of the Philippine Sugar Association at La Carlota Central and further liberations will be made in the near future.

262412—5

THE KAHN TEST IN CLINICAL SYPHILIS [1]

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Since the discovery of the Kahn test, numerous papers discussing the correlation between this test and the Wassermann reaction have been published. However, in the majority of cases, the problem has been approached too much from the serological side of the question. The results are generally based on the total number of cases examined, without much attention being given to the presence or absence of clinical manifestations of syphilis. Comparatively few studies have been submitted in which the serological diagnosis was accompanied by clinical data, especially in regard to the type of syphilitic lesions. In the majority of these reports the percentage of agreement and disagreement is also based on the total number of cases examined, including a large number of nonsyphilitic cases.

It is the purpose of this paper to add something to the general knowledge of the Kahn reaction and to judge the merits of the test in comparison with the water-bath and ice-box Wassermann fixation methods, as performed in the serological laboratory of Johns Hopkins Hospital. The author tried to place himself in the position of a clinician, who first makes the clinical diagnosis and then receives further information from the serological laboratory.

In these records, the writer has endeavored to demonstrate the relative sensitiveness of the Wassermann and the Kahn tests by means of a series of syphilitic cases only, corroborated in each case by the clinical history of the patient.

Parallel Wassermann and Kahn tests were also made with a smaller number of cases showing different clinical types of syphilis that had been submitted to several courses of treatment. The object here was to get an idea of the merits of these reactions as a guide in the treatment of syphilis.

[1] This paper is the result of work done in the School of Hygiene and Public Health, Johns Hopkins University, Baltimore.

The clinical material consisted of syphilitic cases entering the Department of Syphilology in the dispensary of Johns Hopkins Hospital. The majority of these cases were selected and diagnosed by Dr. H. Hopkins, of the clinical staff of the hospital. Only a few of the unselected cases submitted to the serological laboratory are included.

The technic followed in the Kahn test is the procedure described by Kahn in the latest edition of his book [2] in which incubation is almost entirely eliminated and readings are made shortly after mixing the serum and the antigen. In the original method, the weaker reactions required an overnight incubation before the final reading was made.

The antigen used in the experiments here reported was prepared with great care and titrated against a standard antigen obtained from Doctor Kahn's laboratory.

Finally, the comparative tests were made upon the sera from twenty-four hours to four days after bleeding the patients. Under these circumstances, it was found that the age of the serum did not interfere with the results of the precipitation test if the material was kept properly in the ice box.

The Wassermann reaction was performed in the laboratory of Johns Hopkins Hospital.[3] A 0.2 per cent cholesterinized beef-heart antigen was used, and the fixation carried out both in the water bath and ice box. In the water-bath method, a first incubation (water bath) of thirty minutes was allowed for fixation. In the ice-box method, this first incubation was carried out in the refrigerator for three hours. After the first incubation the hæmolytic system was added; for all the tubes were replaced in the water bath at 37° C. for one-half hour before the readings were made.

It will be seen from Table 1 that the cases have been classified in seven groups, as follows:

1. Primary syphilis. Cases with early or more or less healing chancres.
2. Secondary syphilis. Cases with different varieties of skin and mucous membrane lesions.
3. Tertiary syphilis. Skeletal, visceral, and late cutaneous involvements.

[2] Serum Diagnosis of Syphilis by Precipitation; governing principles, procedure, and clinical application of the Kahn precipitation test. Williams and Wilkins Co. (1925).

[3] A complete description of the method is given in an article by Albert Keidel and Joseph D. Moore, The Wassermann reaction in the Johns Hopkins Hospital, Johns Hopkins Bull. 34 (January, 1923) 16.

4. Latent syphilis. Cases in which the Wassermann reaction has been found repeatedly positive. The majority of these cases gave history of chancres, secondaries, or other manifestations and at the time when the blood examination was made were inactive.
5. Syphilis of the central nervous system. Cases of neuro-recurrens, general paresis, tabes, asymptomatic, and other nonspecified lesions of the central nervous system.
6. Congenital syphilis.
7. Nonsyphilitic. Cases with various skin diseases and other clinical manifestations (impetigo, pytiriasis rosea, acne, eczema, dermatitis seborrheicum, carcinoma, pregnancy, abscesses, arteriosclerosis, colloid goiter, fractures, chronic myeloid leukemia, psychoneurosis, endocarditis, and pericarditis).

TABLE 1.—*Showing the number of cases examined and the various types of the disease.*

Type of syphilis.	Number of cases.	Remarks.
Primary	11	Syphilitic chancres. Some positive for treponema.
Secondary	54	Skin lesions, 34 cases. Skin and mucous membranes, 11 cases. Early skin with chancre, 4 cases. Mucous membrane lesions, 5 cases.
Tertiary	29	Skeletal lesions, 9 cases. Visceral (vascular, cardio-vascular, eye) 11 cases. Skin late lesions, 9 cases.
Latent syphilis	35	
Central nervous system	21	Neuro-recurrens, 1 case. General paresis, 4 cases. Tabes, 5 cases. Asymptomatic and not specified, 11 cases.
Congenital syphilis	2	
Nonsyphilitic	68	
Total	220	

The number examined was one hundred fifty-two syphilitic and sixty-eight nonsyphilitic cases. It must be noted, however, that one hundred forty-one cases of the syphilitic series had received treatment before the time the Wassermann and the Kahn tests were performed. In the syphilitic series there were only eleven untreated cases with secondary lesions, and the serological results in these cases showed complete agreement, as demonstrated in Table 5*a*. No false results were found in the sixty-eight nonsyphilitic cases, and the results of the three reactions also showed complete agreement.

Primary syphilis.—Table 2 shows that in eleven cases of primary syphilis the Kahn test gives more definitely positive reactions than the Wassermann water-bath and ice-box fixation methods.

TABLE 2.—*Showing the results of the Wassermann and Kahn tests in eleven cases of primary syphilis.*

[Very strongly positive, ++++; strongly positive, +++; moderately positive, ++; slightly positive, +; doubtfully positive, ±; negative, —.]

Number of cases.	Kahn.	Wassermann.	
		Water bath.	Ice box.
1	++++	++++	++++
1	++++	±	++++
1	++++	—	++++
1	++++	—	++
1	+++	—	+ J–11313 (I–26–29).
2	+++	—	— J–15556 (II–19–29). J–15121 (II–18–29).
1	+	—	—
3	—	—	—

Case J–11313. November 21, 1928. Patient had a ragged crusted ulcer on shaft and a soft dirty shallow ulcer in coronal sulcus. Noticed sore in penis November 3, 1928; exposure six weeks prior. Sore grew worse until present. Dark field, negative. Wassermann 4–4, November 21, 1928. Clinical diagnosis: Syphilis, primary. Seropositive.

TABLE 3.—*Showing the record of treatment and reactions of cases J–11313.*

Date.	Treatment.	Dose.	Wassermann.		Kahn.
			W. B.	I. B.	
		g.			
November 21, 1928	Neoarsphenamine	0.60	++++	++++	
December 1, 1928	do	0.90	++++	++++	
January 11, 1929	do	0.40	++++	++++	
January 18, 1929	do	0.40			
January 26, 1929	do	0.40	—	+	+++

Case J–15556. Patient came to the hospital January 26, 1929, with an ulcer 0.5 by 0.5 centimeter on foreskin near corona. It was covered with a dirty yellow slough and was very tender. Had been treated locally with calmin and peroxide. Dark field, negative. Wassermann, negative (January 26, 1929). No treatment. February 4, 1929, Wassermann = Neg. Neg. February 19, 1929, the penile lesion had a characteristic rolled, indurated border of the syphilitic chancre. Dark field, positive for treponemas. Wassermann Neg. Neg. Kahn 3 (February 19, 1929). One injection of arsphenamine given February 19, 1929. February 26, 1929, Wassermann = Neg. Neg. Kahn 3. Diagnosis: Primary syphilis.

Case J–15121. January 18, 1929, a subacute gonococcus infection. The urethral orifice eroded by a superficial dime-sized soft ulcer. Bilateral

small, hard, indolent, inguinal buboes. Dark field from ulcers showed many nonmotile treponemas. Wassermann reaction = Neg. (water bath) = 4 (ice box). Clinical diagnosis: Syphilis primary. Seropositive.

TABLE 4.—*Showing the record of treatment and reactions of case J–15121.*

Date.	Treatment.	Dose.	Wassermann.		Kahn.
			W. B.	I. B.	
		g.			
January 18, 1929	Neoarsphenamine	0.90			
January 25, 1929	do	0.90	—	+	
February 18, 1929	do	0.90	—	—	+++

Secondary syphilis.—In the forty-three cases of secondary syphilis, the Kahn test was found also more sensitive than the two Wassermann methods employed. See Table 5*a*.

TABLE 5*a*.—*Showing the results of the Wassermann and Kahn tests in forty-three cases of secondary syphilis.*

[Very strongly positive, ++++; strongly positive, +++; moderately positive, ++; slightly positive, +; doubtfully positive, ±; negative, —.]

Number of cases.	Kahn.	Treated cases.	
		Water bath.	Ice box.
16	++++	++++	++++
2	++++	++	++++
2	++++	+	++++
2	++++	—	++++ J–16015 (V–3–29).
1	++++	++	+++
1	++++	—	++
7	++++	—	— J–11391 (III–13–29). J–16247 (IV–10–29).
1	++++	—	— U–7696 (III–20–29).
1	++		
11	—	—	—
UNTREATED CASES			
11	++++	++++	++++

Case J–16015. February 12, 1929, complaint of pain in the joints. Kernels behind ears. Examination showed three large mucous patches on hard and soft palate. Treponemas were demonstrated in these lesions. Post auricular glands very large and firm. Old scars on prepuce. Palms and soles showed dark, firm papules. Clinical diagnosis: Secondary cutaneous palmar and plantar. Arthralgia.

TABLE 5*b*.—*Showing the record of treatment and reactions of case J–16015.*

Date.	Treatment.	Dose.	Wassermann.		Kahn.
			W. B.	I. B.	
		g.			
February 12, 1929	Arsphenamine	0.60			
February 20, 1929	do	0.60			
February 27, 1929	do	0.60	++++	++++	
March 6, 1929	do	0.60	—	++++	++++
March 13, 1929	do	0.40	—	++++	++++
March 20, 1929	do	0.40	—	+	++++
April 5, 1929	do	0.40	—	+++	++++
April 12, 1929	do	0.40	—	++++	++++
April 19, 1929	Bismuth	0.20	—	—	++
April 26, 1929	do	0.20	—	—	++++
May 3, 1929	do	0.20	—	—	++++

Case J–11391. January 14, 1929, numerous follicular indurated papules over bearded region of face, some with tendency to be annular. No lesions on mucous membrane. Penis distorted by large multiple scars and crusted ulcers. Dark field from one of these, negative. Wassermann 4–4 (January 14, 1929). Clinical diagnosis: Secondary early cutaneous folliculopapular.

TABLE 6.—*Showing the record of treatment and reactions of case J–11391.*

Date.	Treatment.	Dose.	Wassermann.		Kahn.
			W. B.	I. B.	
		g.			
January 15, 1929	Neoarsphenamine	0.90	++++	++++	
January 22, 1929	do	0.90	++++	++++	
January 29, 1929	do	0.75	++	++++	
February 5, 1929	do	0.75	++++	++++	
February 12, 1929	do	0.75	++++	++++	
February 19, 1929	do	0.75	++++	++++	
February 26, 1929	do	0.75	—	+	
March 5, 1929	do	0.75	—	—	++++
March 12, 1929	Bismuth	0.20	—	—	++++
March 13, 1929	do	0.20	—	—	++++

Case J–16247. February 13, 1929, a condylomata on right inner thigh, fading papular lesions (about two to three months duration) over arms, palmar and plantar macules. Patient stated that her husband had similar eruptions before she had and was receiving treatment. Wassermann = 4–4. Clinical diagnosis: Secondary early pigmentary condylomata.

TABLE 7.—*Showing the record of treatment and reactions of J–16247.*

Date.	Treatment.	Dose.	Wassermann.		Kahn.
			W. B.	I. B.	
		g.			
February 13, 1929	Neoarsphenamine	0.75	++++	++++	
February 20, 1929	do	0.75			
February 27, 1929	do	0.75	++++	++++	
March 6, 1929	do	0.75		++++	
March 13, 1929	do	0.75	++++	++++	
March 20, 1929	do	0.75			++++
April 4, 1929	do	0.75			++++
April 10, 1929	Bismuth	0.20			++++
April 19, 1929	do	0.20			+++

Case U–7696. January 30, 1929. Complained of soreness on genitalia. Several eroded condylomata lata on vulva were found. Treponemas found by dark field. Wassermann = 2–4. Clinical diagnosis: Secondary early condylomata.

TABLE 8.—*Showing the record of treatment and reactions of case U–7696.*

Date.	Treatment.	Dose.	Wassermann.		Kahn.
			W. B.	I. B.	
		g.			
January 30, 1929	Neoarsphenamine	0.75			
February 6, 1929	do	0.75	+	++++	
February 13, 1929	do	0.75	++	++++	
February 20, 1929	do	0.75			++++
February 27, 1929	do	0.75	+	++++	++++
March 6, 1929	do	0.75	—	—	++++
March 13, 1929	do	0.75	—	++	++++
March 20, 1929	do	0.75	—	—	++++
March 27, 1929	Bismuth	0.20	—	—	+

Tertiary syphilis.—In the twenty-nine cases of tertiary syphilis, as shown in Table 9, the Kahn test was much more sensitive than the Wassermann reaction, especially the water-bath method. In the late cutaneous involvements, the sera examined agree almost completely with the three methods. In the skeletal and visceral syphilis, the Kahn test is definitely more sensitive than the water-bath method. See Table 9.

TABLE 9.—*Showing the results of the Wassermann and Kahn tests in twenty-nine cases of tertiary syphilis.*

[Very strongly positive, ++++; strongly positive, +++; moderately positive, ++; slightly positive, +; doubtfully positive, ±; negative, —.]

Type.	Number of cases.	Kahn.	Wassermann.	
			Water bath.	Ice box.
Skeletal (9 cases)	3	++++	++++	++++
	1	++++	+	++++
	1	+++		++++
	1	++++	—	++ J–12727.
	1	++++	—	— (G–83908 (I–23–1929).
	2	—	—	—
Visceral (11 cases)	2	++++	++++	++++
	2	++++		++++
	1	++++	—	++++
	1	++++	—	++
	1	++++	—	— No. 20149 (I–10–1929).
	1	+++	—	++++
	1	++	—	++++
	1	±	—	—
	1	—	—	—
Late skin (9 cases)	3	++++	++++	++++
	1	++++	+++	++++
	1	++++	++	++++
	1	+	—	—
	3	—	—	—
Total	29			

Case J–12727. Patient complained of pain over right side of head from eye to ear, duration four months. A definite area of tenderness to pressure above the zygomatic bone was found. No tenderness over sinuses or mastoids. Ptosis of right eye, complete inability to move right eye ball. Pupils equal, circular. Vision of both eyes apparently normal by rough tests. Fundi, moderate arteriosclerosis. No change in retina of right eye. No facial paralysis but deviation of the mouth to the right upon showing teeth. On genitalia or dorsum of prepuce there was a definite indurated scar 1 centimeter in diameter. Wassermann = Neg. 2. Kahn 4. Diagnosis: Syphilis. Periostitis of orbit?

Case G–83908. June 16, 1923, gumma of palate and central nervous system (VIII nerve) was diagnosed. Under treatment her deafness (right side) cleared up entirely. Patient received very irregularly three courses of arsphenamine and two of mercury and potassium iodid. The Wassermann test was positive at all times. February 10, 1928, patient was given several injections of arsphenamine and bismuth up to January 23, 1929. January 23, 1929. Wassermann = Neg. Neg. Kahn 4.

During the above second period of treatment the Wassermann became negative for the first time with ice-box method June 22, 1928, and remained

so until January 23, 1929, except on the following dates: October 19, 1928, Wassermann = Neg. 3. January 4, 1929, Wassermann = Neg. 3. Diagnosis: Old gummatous perforation of soft palate.

Case 20149. Patient was operated on October 15, 1928, for a myoma of the uterus (hysterectomy). Very satisfactory post-operative convalescence. Came back to the hospital on December 8, 1928. Physical examination showed an enlargement of heart to the left, apical systoic murmur. Aortic second sound somewhat coarsened. Murmur not transmitted to vessels of neck. Radial arteries thickened. Blood pressure 115/75 left, 125/85 right. No evidence of syphilitic infection. August 22, 1928, Wassermann reaction = Anticomplementary. August 28, 1928, Wassermann reaction = Positive (water bath = 4; ice box = 2). December 11, 1928, Wassermann reaction = Negative.

Two successive Wassermann tests done in the laboratory of the hospital, one on December 11, 1928, and the other on January 10, 1929, using the ice-box method were also negative. A Kahn test was performed at the latter date and the result was 4 plus. An X-ray examination showed dilatation of the aorta and enlargement of the heart.

March 6, 1929, the patient was given an injection of neoarsphenamine (0.30 gram), and the Wassermann test then became strongly positive (4–4). The treatment was continued until April 10, 1929. During the course of this treatment the Wassermann test was constantly 4–4. Impression. Syphilis (seropositive).

Myocardial degeneration with some changes in the aorta (etiology may be lues, arteriosclerosis; uterine myomata may have some bearing).

Asymptomatic cases.—In this group of asymptomatic cases, as demonstrated in Table 10, the Kahn test is again more sensitive than the Wassermann reaction. This shows that the Kahn test is perhaps a more dependable procedure than the complement fixation for the diagnosis of chronic syphilitic cases.

TABLE 10.—*Showing the results of the Wassermann and Kahn tests in thirty-five cases of latent syphilis.*

[Very strongly positive, ++++; strongly positive, +++; moderately positive, ++; slightly positive +; negative, —.]

Number of cases.	Kahn.	Wassermann.	
		Water bath.	Ice box.
17	++++	++++	++++
1	++++	+++	++++
1	++++	—	++++
1	++++	—	++
1	++++	—	— J–2506 (I–23–1929).
2	+++	—	— H–93343 (I–15–1929).
2	++	—	—
3	+	—	— H–13182 (XI–7–1928).
7	—	—	—

Case J–2506. In 1911 at the age of 16, patient had a genital sore that was thought to be a primary lesion. There was no record of her having received any antisyphilitic treatment. She came back in 1922 complaining of generalized pruritus. A diagnosis of syphilis (seropositive) was made at that time. Out of four Wassermann tests performed, two were positive and two were negative. She received 3 doses of diarsenol and did not present herself again until August 17, 1928, when she complained of essentially the same, generalized pruritus. Patient's history was essentially negative, except for shortness of breath on exertion and micturition (5 or 6 times each night). Blood and spinal Wassermann were negative.

October 12, 1928, patient was given an injection of silver arsphenamine, 0.1 gram. October 19, 1928, the Wassermann showed water bath = negative; ice box = 1. Another injection October 19, 1928, of silver arsphenamine 0.1 gram. December 7, 1929, the Wassermann showed water bath = negative; ice box =1. Another injection October 19, 1928, of silver arsphenamine 0.1 gram. December 7, 1929, the Wassermann was Neg.–Neg. The patient was given six injections of arsphenamine (0.20 gram each), and one injection of bismuth (0.20 gram) up to January 23, 1929. Repeated Wassermann during this treatment remained negative.

On January 23, 1929, blood was tested again for Wassermann and Kahn. The results were the following: Wassermann Neg.-Neg. Kahn 4. Diagnosis: Syphilis Wassermann reaction (1922).

Case H–93343. History of syphilis. February 17, 1928, the Wassermann reaction showed water bath = negative; ice box = 4. Patient was given arsphenamine and bismuth and the Wassermann reaction in July, 1928, became completely negative. January 15, 1929, patient came again to the hospital. This time the Wassermann reaction was found negative, but the Kahn test positive (+++). At this time, however, there was no evidence of syphilis on physical examination. Diagnosis: Latent Wassermann reaction, late (1928).

Case H–13182. Patient had one premature spontaneous delivery (stillborn baby) on December 4, 1924. Denies venereal infection. Wassermann = 4–4 on December 16, 1925. Positive. (Patient's husband received antisyphilitic treatment at that time in the dispensary of the hospital.) Patient came for the second time to the hospital in 1927. Started treatment with silver arsphenamine, neoarsphenamine and bismuth from February 23, 1927, to January, 1928. During the course of this treatment the Wassermann remained negative.

November 7, 1928, Wassermann Neg.-Neg, Kahn test 1. Diagnosis: Latent syphilis (1925).

Syphilis of the central nervous system.—In the twenty-one cases examined, the Kahn test is undoubtedly more sensitive than the Wassermann water-bath method.

Congenital syphilis.—In the two cases examined the results were identical.

TABLE 11.—*Showing the results of the Wassermann and Kahn tests in twenty-one cases of syphilis of the central nervous system and in two cases of congenital syphilis.*

[Very strongly positive, ++++; strongly positive, +++; moderately positive, ++; slightly positive, +; negative, —.]

Type.	Number of cases.	Kahn.	Wassermann.	
			Water bath.	Ice box.
Neurorecurrens	1	++++	++++	++++
General paresis (4 cases)	1	++++	—	++ H–811 (XII–10–28).
	2	++++	—	— H–56170 (I–23–29).
	1	—	—	—
Tabes (5 cases)	1	++++	++++	++++
	1	++++	—	—
	1	+	—	—
	2	—	—	—
Asymptomatic and nonspecified (11 cases)	3	++++		
	1	++++	++++	++++
	1	++++	+	++++
	1	+++		++++
	1	++	—	++
	1	+	—	—H–30276 (XI–5–1928).
	3	—	—	
Congenital	2	++++	++++	++++

Case H–811. Patient in 1924 complained of nervousness, speech trouble, and weakness. Denied lues and gonorrhea. Had headaches and difficulty of vision for five years. Pupils irregular. No reaction to light. Marked tremor of tongue and facial muscles. Marked slowing and slurring of speech, but test phrases were pronounced quite well when patient really tried. Tremor of hands. Patient's memory quite good.

Globulin test 4. Wassermann of spinal fluid (positive, 1 cubic centimeter). Colloidal mastic, 5555554321.

Patient received treatment with tryparsemide from May 23, 1924, to January 20, 1925. Patient came back to the hospital December 10, 1928. At this time Wassermann showed water bath = Neg., Ice box = 2. The Kahn test = 4. Diagnosis: General paresis.

Case H–56170. Patient was seen first in psychiatric clinic August 17, 1926, with a complaint of loss of consciousness and failing memory.

Globulin 4. Wassermann, water bath = Neg., Ice box = 4. Mastic test, 5543210000.

Treatment began September 15, 1926, with neoarsphenamine-tryparsemide and bismuth. Blood Wassermann remained negative as a result of treatments in October, 1928, up to January 23, 1929.

January 23, 1929, Wassermann Neg. Neg., Kahn 4. Diagnosis: Central nervous system syphilis (paresis). Aortic insufficiency.

TABLE 12.—*Showing the influence of treatment upon the Kahn and Wassermann tests in eleven cases with different varieties of syphilis.*

[4=++++; 3=+++; 2=++; 1=+; −=negative.]

Type of syphilis.	Number of cases.	Clinical diagnosis.	Treatment.																	
			First.			Second.			Third.			Fourth.			Fifth.			Sixth.		
			K	Wass.		K	Wass.		K	Wass.		K	Wass.		K	Wass.		K	Wass.	
				WB	IB		WB	IB		WB	IB		WB	IB		WB	IB		WB	IB
Primary	1	Chancre (3 weeks duration)	4	4	4	4	4	4	4	4	4	4	2	4	3	—	2	4	—	2
Do	1	Early cutaneous macular	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Do	1	Early cutaneous maculo papular	4	4	4	4	—	4	4	2	4	4	—	3	3	—	3	3	—	—
Secondary	1	Cutaneous (condylomata)	4	4	4	4	4	4	4	4	4	4	1	1	4	—	3	4	—	2
Do	1	Early papular with chancre	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Do	1	Early mucous membrane with chancre	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	4
Do	1	Early papular	4	4	4	4	4	4	4	—	1	3	—	—	3	—	—	+	—	—
Do	1	Late skin nodular	4	2	4	4	—	4	—	—	4	4	—	4	4	—	4	—	4	4
Tertiary	1	Bone. Osteitis of skull and mandible	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Do	1	C. N. S. (8th nerve)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Do	1	Latent Wassermann. Has congenital syphilitic children	4	4	4	4	4	4	4	4	4	4	4	4	4	—	4	4	—	2

Type of syphilis.	Number of cases.	Clinical diagnosis.	Treatment.												Drug.	Total amount given.
			Seventh.			Eighth.			Ninth.			Tenth.				
			K	Wass.		K	Wass.		K	Wass.		K	Wass.			
				WB	IB		WB	IB		WB	IB		WB	IB		g.
Primary	1	Chancre (3 weeks duration)	K	—	—	4	—	—	3	—	—	3	—	—	Neoarsph	6
Do	1	Early cutaneous macular	4	1	4	4	4	4	2	—	1	2	—	—	do	2.52
															Bismuth	0.60
Do	1	Early cutaneous maculo papular	3	—	—	3	—	—							Neoarsph	3
Secondary	1	Cutaneous (condylomata)	4	—	4	4	—	2	4	—	—	4	—	—	do	3.55
															Bismuth	0.60
Do	1	Early papular with chancre	4	—	—										Neoarsph	6
Do	1	Early mucous membrane with chancre	4	1	3	4	—	1	3	—	—	2	—	—	do	5.70
															Bismuth	0.40
Do	1	Early papular													Neoarsph	4.20
Do	1	Late skin nodular	4	4	4	4	4	4							Arsph	1.80
															Neoarsph	1.20
Tertiary	1	Bone. Osteitis of skull and mandible	4	1	4	4	4	4	4	—	4	4	—	4	Arsph	2
															Neoarsph	0.45
															Bismuth	0.80
Do	1	C. N. S. (8th nerve)	4	4	4	4	4	4	4	4	4	4	4	4	Arsph	1.80
															Bismuth	0.80
Do	1	Latent Wassermann. Has congenital syphilitic children	4	—	3	4	3	4	3	—	2	4	2	3	Neoarsph	4.80
															Bismuth	1.40

Case H–30276. Patient, seen May 5, 1928, complains of severe headaches at menstrual periods and sore throat. No clinical evidence of lues. One year before patient had miscarriage (in the third month).

May 12, 1928, spinal fluid Wassermann 4–4 (1 cubic centimeter and 0.4 cubic centimeter of fluid). Colloidal mastic test, 2221000000.

Patient started treatment (arsphenamine, neoarsphenamine and bismuth) May 1928.

November 5, 1928, Wassermann blood Neg. Neg., Kahn 1.

Influence of treatment upon the Kahn and Wassermann tests.—The influence of treatment upon the Kahn and Wassermann tests was studied in 25 cases, which received weekly intravenous injections of arsphenamine and neoarsphenamine. Bismuth was also used in cases with secondary and tertiary manifestations of the disease. In Table 12, we selected 11 cases that were fair representations of the different varieties of syphilis. The results showed that the Kahn precipitation test remains positive longer in patients under the influence of various treatments than either of the complement-fixation reactions. Therefore, in the presence of a known case of syphilis, a negative Kahn test will have perhaps a greater diagnostic value than the Wassermann methods.

SUMMARY AND CONCLUSIONS

Two hundred twenty cases were studied under clinical control and comparisons were made between the Kahn and the Wassermann tests. The water-bath and the ice-box methods with a sensitive antigen were used in the Wassermann reaction, and the latter method was found the more delicate of the two. The technic employed in the Kahn test was the latter method, proposed by its author. The results seem to agree in general with those obtained by other investigators in regard to the sensitiveness of the Kahn test. In the few nonsyphilitic cases examined no false results have been observed, and in the syphilitic cases, the Kahn test has consistently appeared more pronounced especially in latent syphilis, and in cases under the influence of treatment, as compared with the Wassermann ice-box fixation method. Compared with the ordinary water-bath method, the Kahn test is undoubtedly very much more sensitive. We feel, therefore, that the Kahn reaction when properly done and properly interpreted is a valuable test for the serological diagnosis of syphilis and should be used in routine work in conjunction with the Wassermann reaction, particularly when the water-bath method is the only method used. It will give the physician a more dependable laboratory diagnosis than the Wassermann water bath alone could give.

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COMPARATIVE SEROLOGIC STUDY OF VERNES, WASSERMANN, AND KAHN REACTIONS IN EXPERIMENTAL TREPONEMATOSES

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In the course of the investigations performed by Dr. Otto Schöbl(1) and his collaborators on experimental yaws and syphilis in Philippine monkeys, hundreds of these animals were inoculated with yaws, syphilis, or both.

Through the courtesy of these investigators, I was permitted to utilize the blood of some of these experimental animals for the purpose of studying the sensitiveness of the Vernes method, as compared with the Wassermann and Kahn methods, and of determining whether or not the Vernes reaction gives regular results in yaws- or syphilis-infected Philippine monkeys.

MATERIAL INVESTIGATED

For the information of the reader the following data must be mentioned:

1. The blood of twenty-one infected Philippine monkeys was examined and reported for this paper. The majority of these animals had been inoculated within the last five years.
2. The strains of *Treponema pertenue* were secured by direct inoculation from patients in the Philippines to monkeys, and were maintained alive through successive passages in monkeys.
3. The strain of *Treponema pallidum* used in these monkeys was the well-known laboratory strain known as "Nichols strain."
4. Some of these monkeys had received some intramuscular injections of neosalvarsan in the past, and a few had received injections of heated antitreponematous vaccines.
5. In this investigation ten normal Philippine monkeys were tested as controls. The blood of these normal animals invariably gave negative results with the Vernes, Wassermann, and Kahn tests.

TECHNIC

During this investigation the Wassermann and Kahn tests were performed by Dr. Onofre Garcia, of the biologic division, Bureau of Science, on the day following the bleeding of the animals. The technic for the Wassermann test was the same as that described previously by Dr. Otto Schöbl and the writer; (2) that is, guinea pig's complement, antimonkey hæmolytic system, and cholesterinized antigen.

The technic followed in performing the precipitation test is the standard method of Kahn. (3)

The samples of blood for the Vernes test were received by the present author at irregular intervals, and the Vernes reaction was performed with the sera at periods of from two to ten days after the bleeding of the animals.

The Vernes reaction was performed by following exactly Professor Vernes's technic, which the author of this paper learned in the laboratory of Professor Vernes, at the Prophylactic Institute of Paris, during his last trip to France in the autumn of 1929.

The results of the Wassermann and Kahn tests are as follows:

Very strongly positive	++++ (100 per cent hæmolysis).
Strongly positive	+++ (75 per cent hæmolysis).
Moderately positive	++ (25 per cent hæmolysis).
Slightly positive	+ (10 per cent hæmolysis).
Very slightly positive (doubtful)	± (5 per cent hæmolysis).
Negative	— (no hæmolysis).

The results of the Vernes reaction in our tables are given in figures that exactly represent the numbers of the photometric readings of each sample of blood. In this way, and following the advice of Professor Vernes, misinterpretations were avoided in the results of the Vernes reaction when compared with the nomenclature generally adopted in the readings of the Wassermann and Kahn tests.

Since the Vernes method gives to the clinician a more quantitative measurement of the treponematous infection in the patient than either the Wassermann or the Kahn test, because the reading in the first test is made by means of a photometer, the table adopted by Vernes for the clinical interpretation of these figures is also given here.

The following table is based on a great number of clinical and serologic studies of normal and syphilitic patients.

SYPHILIMETRIC TABLE

Photometric reading –0. This means a completely normal serum.

Photometric reading 1–2. This means a normal serum, although somewhat doubtful.

Photometric reading 3–4. In 100 normal sera, there were only 2 sera that gave the values 3–4. In 100 sera taken at random approximately 25 syphilitic sera were found which gave the values 3 and 4. The formula is $\frac{25 - 3}{75 \times N}$.

Photometric reading 5–6. In 500 normal sera, only one serum gave the values 5–6. In 100 sera taken at random approximately 50 syphilitic and 50 non-syphilitic sera gave the values 5 and 6. The formula is $\frac{50 - 3}{50 \times N}$.

Photometric reading 7, 8, 9, 10, 11. In 2,000 sera there were approximately 1.999 syphilitic sera and only one non-syphilitic serum. The formula is $\frac{1.999 - S}{1 - N}$.

Photometric reading 12, 13, 14, 15, 16, 17, 18. In 10,000 sera there were 9.999 syphilitic sera and only one non-syphilitic serum. The formula is $\frac{9.999 - S}{1 - N}$.

Photometric reading 19, 20, 21, 22, 23, 24, 25, 26, 27. In 650,000 sera there were approximately 649.999 syphilitic sera and only one non-syphilitic serum. The formula is $\frac{649.999 - S}{1 - N}$.

Values higher than the photometric reading 27. Indicate syphilitic infection without exception. The formula is S — sure.

Taking into consideration the results obtained with the Wassermann reaction, our twenty-one sera examined here were classified as follows:

	Number of sera.
Slightly positive +	7
Moderately positive (++)	2
Strongly positive (+++) and (++++)	12
Total	21

RESULTS OF TESTS

The results of the tests presented in Table 1 show that the Vernes method follows the results of the Wassermann test more closely than those of the Kahn test, with the exception of monkey 12, and that in the slight reactions the Vernes test gives more definite and clear-cut results than the Wassermann test itself. In regard to the Kahn test, Vernes reaction is also more sensitive in the slight reactions.

TABLE 1.—*Showing the results of the blood in seven infected Philippine monkeys.*

Monkey.		Test.				
Number.	Designation.	Wassermann.	Kahn.	Date performed.	Vernes.	Date performed.
6	Yac–10	+	++	7– 1–30	4	7–11–30
7	Sy–D–20	+	+	7– 7–30	10	7–11–30
8	F–38	+	±	7– 7–30	11	7–11–30
9	Ym–20 no clip	+	+	7–23–30	6	7–29–30
10	L–13 right	+	—	7–23–30	5	7–29–30
11	Sy–3	+	±	6–24–30	10	6–26–30
12	K–28	+	+	7– 9–30	0	7–13–30

Table 2 shows the results of the tests of two moderately positive sera. The Vernes reaction here also seems to be more sensitive than the Wassermann, more especially in monkey 13, and more sensitive than the Kahn test in monkey 14.

TABLE 2.—*Showing the results of the tests in two moderately positive sera.*

Monkey.		Test.				
Number.	Designation.	Wassermann.	Kahn.	Date performed.	Vernes.	Date performed.
13	L–15 cut tail	++	+++	7–23–30	22	7–29–30
14	W–23	++	±	11– 4–30	7	9–11–30

TABLE 3.—*Showing the results of the Vernes, Wassermann, and Kahn tests in strongly positive sera from infected Philippine monkeys.*

Monkey.		Test.				
Number.	Designation.	Wassermann.	Kahn.	Date performed.	Vernes.	Date performed.
15	Yac–12	++++	++++	7– 1–30	94	7–11–30
16	B–9	++++	++++	7– 1–30	60	7–11–30
17	E–14–instr. tail	++++	++++	7– 7–30	62	7–11–30
18	O–C both clip	++++	—	7–24–30	32	7–29–30
19	Sy–P–23	++++	—	7–24–30	49	7–29–30
20	K–13–left	++++	+	7–24–30	76	7–29–30
21	Yaw–V–10	++++	++++	6–20–30	91	6–26–30
22	F–2	++++	++++	8– 6–30	67	8–13–30
23	J–1	++++	++	8– 6–30	89	8–13–30
24	G–25	++++	++++	8– 8–30	136	8–13–30
25	J–11	++++	++	10–30–30	25	11– 4–30
25	W–25	+++	++	11– 4–30	14	11–11–30

Table 3 shows the results with strongly positive sera from twelve infected Philippine monkeys. The Vernes reaction follows again more closely the results of the Wassermann rather than the Kahn test and gives a better measure of the amount of the treponematous "reagin" in vivo.

SUMMARY

The blood of twenty-one Philippine monkeys infected at different intervals of time with yaws, syphilis, or both, have been tested. A few of these animals received neosalvarsan treatments in the past and also injections of heated antitreponematous vaccines.

The results of the Vernes, Wassermann, and Kahn tests agree in a general way, but the Vernes reaction follows more closely the results of the Wassermann test in spite of the fact that the Vernes reaction was performed a long time after the bleeding of the animals. This circumstance necessarily will bear some influence on the results and the sensitiveness of the test. Nevertheless, in our series the Vernes test is found somewhat more sensitive than our Wassermann test.

Since the readings of the Vernes test are made by means of a photometer and the results are expressed in figures, a more accurate quantitative measurement of the "reagin" is made possible. The results, therefore, are more helpful especially for the clinical interpretation of weakly positive and border line results for which the reading of the Wassermann and Kahn tests are usually insufficient.

It must be borne in mind that the precipitation reactions in Philippine monkeys give much lower results than the Wassermann test, as proven by Doctors Schöbl and Garcia with the Kahn test. Nevertheless the Vernes reaction, being a precipitation reaction, gives higher values, or did in our experiments, than both the Wassermann and Kahn tests.

CONCLUSIONS

1. In Philippine monkeys inoculated with yaws or syphilis, the Vernes reaction was found regularly positive.

2. This fact shows the sensitiveness of the reaction of Vernes, which is a precipitation reaction. It is known that precipitation reactions (Kahn) are not as pronounced in Philippine yaws or syphilitic monkeys as the Wassermann test.

3. This is particularly evident in sera with a low and a moderate degree of positive reaction (Table 1), whether compared with Wassermann or Kahn reaction.

4. Sera from infected Philippine monkeys giving high positive values with Wassermann reaction likewise give high values with Vernes reaction, unlike those with Kahn.

5. With regard to Philippine monkeys the Vernes reaction seems to have an advantage over both the Wassermann and Kahn tests.

REFERENCES

1. SCHÖBL, OTTO. Philip. Journ. Sci. 35 (1928) 209.
2. SCHÖBL, OTTO, and CARLOS MONSERRAT. Philip. Journ. Sci. § B 12 (1917) 249.
3. KAHN, R. L. Serum diagnosis of Syphilis by Precipitation; governing principles, procedure, and clinical application of the Kahn precipitation test. Williams and Wilkins Co. (1925).

MALARIA TRANSMISSION IN THE PHILIPPINES, IV

METEOROLOGICAL FACTORS [1]

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THREE TEXT FIGURES

Mayne, [2] in his article on the influence of relative humidity on the presence of malarial parasites in the insect carrier, mentions the work of Bentley on the influence of temperature and humidity on the malaria incidence of Bombay between 1909 and 1911, which brought to light a definite relationship between the months of heaviest infections and the phenomenon of relative humidity. Bentley found that the occurrence of new infections coincided with a period of slightly lower but not more uniform high temperature in the presence of increased humidity. Mayne's work covered dissection of 5,052 mosquitoes from March to September, 1927, in the District of Saharanpur, United Provinces, India. Out of this number, he found five infected *A. calicifacies*—Giles (total number of this species, 2021) collected from August 9 till September 8, a period with the highest relative humidity (82 to 99 per cent). Gill,[3] in his epidemiological methods of forecasting seasonal appearance of endemic or epidemic malaria in Punjab, India, uses biological as well as meteorological factors. Wenyon [4] believes that in the natural infection of mosquitoes, temperature is a much more important factor than humidity. He asserts that there is no evidence that the effects of humidity of the atmosphere play any part in the active development of parasites to the mosquitoes. "Provided there is sufficient moisture in the air to enable the mosquito to live, the malarial parasites will develop normally." He agrees with

[1] From the field laboratory, division of malaria control, Philippine Health Service, Tungkong Manga, Bulacan. The writer expresses here his gratitude to Father Miguel Selga, director of the Weather Bureau, for his personal interest, valuable suggestions, loan and installation of instruments, and training of the laboratory personnel in making observations.

[2] Indian Journ. Med. Res. 15 (1928) 1073.

[3] Cited from Mayne.

[4] Cited from Mayne.

Gill that the spread of malaria may, however, be affected by lack of humidity, but only on biological grounds, because the mosquitoes which ingest parasites may not live long enough for sporozoites to appear in the salivary glands. In Europe (North Holland)[5] malaria in mosquitoes is prevalent in autumn and winter with its maximum in November or December, while malaria in man is a phenomenon of spring and summer with its maximum in June or July. Swellengrebel (p. 25) says:

> The fact that in two localities so near each other as Nieuwendam and Wormerveer or Sloten, there is no synchronism in the epidemic periodicity (beginning of epidemic in Nieuwendam in 1912 with remission in 1914–1917, at Wormerveer beginning of epidemic in 1918, at Sloten in 1921) makes it doubtful whether climatic conditions can have much influence. On the other hand, the synchronous decline of the epidemic in 1923 indicated the presence of a common inhibiting factor. Was this factor the low temperature of the fourth quarter of 1922 and the first and second quarters of 1923? If so, why did the epidemic cease at Wormerveer after 1902 and why did it show a remission in Nieuwendam? Have the dryness and high temperature anything to do with it; if so, why did not the climate in 1911 produce a similar effect? (The following year witnessed an exacerbation of epidemic at Nieuwendam.)
>
> These considerations make it impossible to attribute any epidemiological importance in the climatic changes observed here, the more so as no influence can be detected on the anopheline population.

Granting that the epidemics were diagnosed correctly, Swellengrebel's conclusions are to be expected but his data are subject to further analysis, for, (1) to expect synchronism in the epidemics between 1912 and 1921 in the three nearby places due to a common cause (climate) several variable factors, as the mosquito density, the number of suitable human carriers, and their accessibility to the mosquito, including those of the susceptibles, should be equally present in all. (2) The introduction of a new parasite strain in one place and not in the others should be considered. On the other hand, the synchronous decline of malaria in 1923 cannot be explained by such variable factors as coincident decrease in the number of suitable carriers, immunity, treatment of cases, mosquito control, improved living conditions, etc., all happening at the same time in the three places, all the more so when the campaign in these places from 1920 to 1923 was limited to mosquito control measures, and at Nieuwendam, this work was confined to catching adults in the stables only (pp. 31-35). Since

[5] Principles and Methods of Antimalarial Measures in Europe:2d general report of the Malaria Commission, League of Nations (1927) 61. Malaria in the Kingdom of the Netherlands (1927) 67–70, graphs 4 and 5.

climatic records are available from 1902 to 1923, while the anopheles data are only available for the years 1920 to 1923, the rôle of the transmitter under the existing climatic conditions in the incidence of malaria from 1902 to 1919, inclusive, is not known. The trend of the disease during this period cannot and should not be explained on the basis of the mosquito findings from 1920 to 1923 alone. It would seem, therefore, that in the synchronous decline of the epidemic in 1923, with a parallel trend of the disease from 1921 to 1923 in the three places mentioned, (graph 5, p. 70) while no climatic influence was detected on the anopheline population, one cannot eliminate entirely a common inhibiting factor (the low temperatures in the fourth quarter of 1922 and the first and second quarters of 1923). Neither can the influence of the climate on the behaviors of the disease and on the mosquitoes previous to 1920 be ignored because anopheles and human carrier data are not available or have not been utilized.

One point is indisputable in Swellengrebel's observations, and that is the coincidence of malaria in mosquitoes with the months of high relative humidity (see his table 4*a*, p. 45 and graph 6, p. 71).

The results of two years (September, 1927, to August, 1929) systematic captures and dissections for natural malaria infection of *A. funestus* Giles in two adjacent camps of La Mesa and South Portal of the Novaliches water project,[6] form the basis of the present article. Meteorological records were taken from the field laboratory at Tungkong Manga, 9 to 10 kilometers north of La Mesa and South Portal but at about the same elevation (100 meters) above sea level. Unfortunately, these observations were not carried on simultaneously with the mosquito observations, but were from September, 1929, to August, 1930, and may differ from those obtaining from September, 1927, to August, 1929. The average monthly rain gauge readings from September, 1927, to August, 1929, at La Mesa, however, show the same proportionate distribution as those from September, 1929, to August, 1930, at Tungkong Manga, although somewhat lower. Any difference in temperature and relative humidity between the two periods at the two places would probably be a difference in degree only and not in distribution. The use of meteorological data for September, 1929, to August, 1930, therefore, seems justified and should give at least a relative value.

[6] See the preceding three papers.

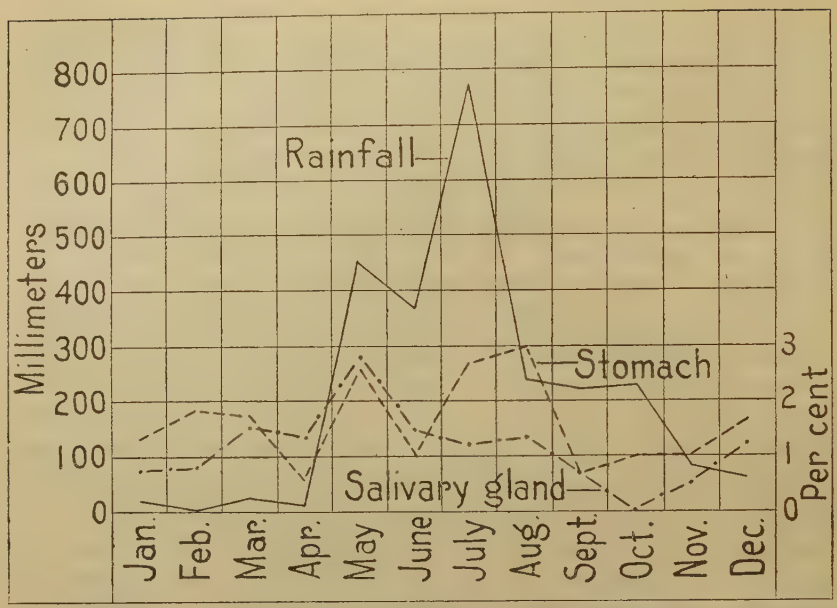

FIG. 1. Showing a rise of the rates of infection in *Anopheles funestus* during the period of heaviest rain although the infections were also present during the dry months.

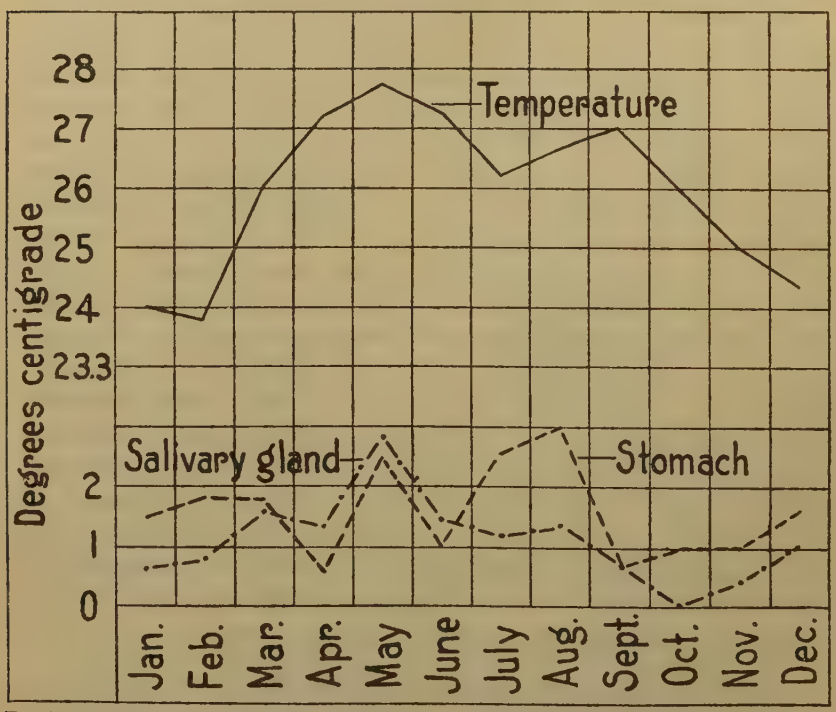

FIG. 2. Showing a rise of the rates of infection in *Anopheles funestus* during the warmest months although they were also present during the cool months.

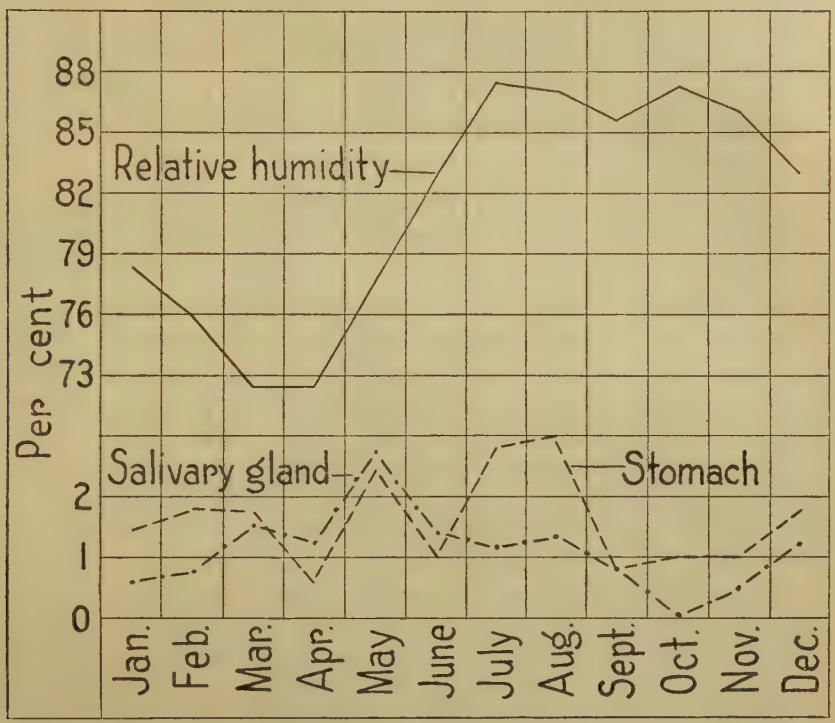

FIG. 3. Showing some rise in the rates of infection in *Anopheles funestus* during the months of high relative humidity although they were also present in March and April, months with the lowest percentage of relative humidity.

TABLE 1.—*Dissection of funestus from La Mesa and South Portal.*

Month.	Number dissected.	Positive stomachs.	Per cent.	Positive salivary glands.	Per cent.
January	932	11	1.2	8	0.8
February	327	6	1.8	3	0.9
March	878	15	1.7	14	1.6
April	668	4	0.6	9	1.3
May	686	18	2.6	19	2.8
June	782	8	1.0	11	1.4
July	883	23	2.6	10	1.1
August	571	17	3.0	7	1.2
September	1,058	8	0.7	8	0.7
October	1,190	12	1.0	2	0.1
November	767	8	1.0	4	0.5
December	803	14	1.7	9	1.1

Table 1 shows the monthly catches and infections found during the period of observation. The influence of larval control on the adult density and uncontrolled movements and quininization of

TABLE 2.—*Meteorological observations at Tungkong Manga.*

Month.	Rainfall.						Temperature.						Relative humidity and vapor tension.			
	6 a. m.		2 p. m.		Total, 24 hours.		6 a. m.		2 p. m.		Minimum.	Maximum.	6 a. m.		2 p. m.	
							Dry.	Wet.	Dry.	Wet.			R. H.	V. T.	R. H.	V. T.
	in.	*mm.*	*in.*	*mm.*	*in.*	*mm.*										
January	0.15	3.9	0.39	9.9	0.54	13.8	18.7	18.2	29.0	23.5	17.7	30.4	95	15.3	62	18.3
February	.0	.0	.0	.0	.0	.0	17.6	17.0	29.9	23.7	16.4	31.4	95	14.2	57	18.0
March	.602	15.4	.10	2.5	.702	17.9	19.4	18.7	31.9	24.4	18.5	33.6	93	15.6	52	18.0
April	.051	1.3	.314	8.0	.369	9.3	20.9	20.1	32.2	25.0	19.8	34.5	90	17.1	55	19.1
May	10.070	246.0	7.841	199.2	17.911	455.2	23.4	22.5	31.3	25.5	22.4	33.2	92	19.8	63	20.6
June	9.175	233.4	5.036	127.9	14.211	361.3	23.4	22.8	29.8	26.4	22.7	31.9	95	20.3	71	21.8
July	19.644	499.1	10.749	273.0	30.393	772.1	24.4	23.8	28.0	25.4	23.2	29.2	94	21.4	81	22.4
August	5.977	151.8	3.555	90.4	9.532	242.2	23.6	23.1	28.0	25.9	22.9	30.5	96	20.8	78.5	22.3
September	2.371	60.2	2.912	73.9	5.283	210.0	22.9	22.4	29.8	26.7	22.3	31.7	95	19.8	76	23.4
October	4.75	119.9	3.926	99.7	8.656	218.6	22.4	22.06	28.2	25.2	22.12	29.98	96	19.5	78	22.0
November	2.442	62.1	1.289	32.8	3.731	94.9	21.2	20.96	28.0	24.7	20.7	29.4	97	18.39	75	21.19
December	2.018	51.2	.497	12.7	2.515	63.9	19.6	19.2	28.5	24.2	19.2	29.7	96	16.1	69	19.3

the population on mosquito infection are not known. Temperature shows no apparent influence on breeding and adult density in this locality.

Table 2 shows the monthly mean meteorological observations.

COMMENTS

Given a favorable adult *funestus* density, a community of the topography of South Portal with a low rate of suitable human carriers would be expected to have a seasonal prevalence of malaria coinciding with the months of most rainfall, high mean temperature and relative humidity. Areas where the *funestus* breeding streams dry out during the dry months, would be expected to have malaria during the rainy season. On the other hand, localities where the breeding is limited to permanent streams, heavy rains would flush the larvae, reduce the density and transmission even in the presence of suitable carriers. Since *funestus* has been found infected in nature in all months of the year provided suitable carriers are available, the observed prevalence of malaria during the rainy season in one region and dry season in another, may be explained by the influence of the rain on the amount of breeding and the resultant adult density of the transmitter. Both types of breeding, permanent and temporary streams, exist in the Novaliches water project, as previously mentioned,[7] and explains the uniform high *funestus* density observed in the camps in 1927 and 1928. The natural decline in *funestus* density observed in South Portal in 1929 and 1930, and in North Portal and Tungkong Manga in 1929, (the former dropping in February, the latter in May) cannot be explained.[8]

SUMMARY

1. From the available mosquito data at the La Mesa and South Portal camps of the Novaliches water and meteorological data at the field laboratory in Tungkong Manga, malarial infection in *A. funestus* Giles shows a rise in the rates with the increase of rainfall, mean temperature and relative humidity, although infections were also present during the dry, cool, and less humid months.

2. *Anopheles funestus* breeds in permanent or temporary streams and the influence of the rainy season on breeding and the resultant adult density probably explains the different seasonal distribution of malaria transmission in the Philippines.

[7] Manalang, Philip. Journ. Sci. 37 (1928) 123.

[8] See preceding article.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Graph showing a rise of the rates of infection in *Anopheles funestus* during the period of heaviest rain although the infections were also present during the dry months.

2. Graph showing a rise of the rates of infection in *Anopheles funestus* during the warmest months although they were also present during the cool months.

3. Graph showing some rise in the rates of infection in *Anopheles funestus* during the months of high relative humidity although they were also present in March and April, months with the lowest percentage of relative humidity.

LEAF AND SEED STRUCTURE OF A PHILIPPINE CORIARIA

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FOUR PLATES

This rare shrub, a species of *Coriaria,* occurs in the Mountain Province, northern Luzon, and is the only species recorded in the Philippines under the small family *Coriariaceæ.* It is botanically known as *Coriaria intermedia* Matsumura. For a number of years this plant has been a subject for research on account of the reputed poisonous properties of its leaves and seeds. Chemical and toxological investigations have been made and at present a still more extensive research on the same line is being conducted. Very interesting results have already been obtained. This critical study of the structure of the leaf and seed of the Philippine *Coriaria* was undertaken, therefore, with a view to having a definite basis for the identification of fragments of the plant in cases of poisoning. Then, too, it was thought that this plant, being rare in this country, might show some structure useful to the systematic anatomy of the Phanerogams.

The late Eduardo Lete, pharmacist from San Fernando, La Union, was the first to report the poisonous properties of Philippine *Coriaria* to the Bureau of Science about the year 1915. During the summer of 1916, while the writer was detailed in Benguet by the Bureau of Science to collect some botanical specimens, he obtained direct information from some of the natives in Trinidad valley, Baguio, concerning the poisonous effects on man of this plant, commonly known by them as *buakat,* or *backet.* He was told that at one time a certain couple with their two children died of poisoning after taking a decoction of the fruits and leaves of *buakat* or *backet,* which they mistook for their native Benguet tea, because of the similarity of the two plants. In the summer of 1918, a year later, the writer was assigned to conduct a more extensive botanical exploration in Haight's Place and vicinity, about 60 miles north of Baguio. He collected several kilos of the fruits and shoots of Philippine

Coriaria and from this material attempts to isolate its active principle and to conduct experiments showing its action upon animals were made by the chemists of the Bureau of Science. In 1919, Wells(7) reported that *Coriaria intermedia* contains a poisonous glucoside in its leaves and fruits.

Lindsay(2) claims that in New Zealand there are at least three species of *Coriaria;* among them is *Coriaria ruscifolia* Linnæus, the most abundant and popularly known as toot-poison because of its poisonous properties. The action of the poisonous portions of this plant on man, cattle, and on sheep were described by him respectively. He indicated that toot-poison belongs to the class narcotico irritants.

Among the known species of *Coriaria,* the only one that has been thoroughly investigated is *Coriaria myrtifolia* Linnæus. This species is found distributed in the southern part of France, Spain, and Italy. According to Reutter(5) it contains a glucoside called coriamyrtin and an alkaloid coriarine, also a considerable amount of tannin and resinous substances. Its important anatomical features described by Solereder(6) may be summarized as follows: (*a*) The stomata occur on both surfaces of the leaf and they are adjoined on either side by a single subsidiary cell, parallel to the pore; (*b*) the upper and lower epidermal cells in surface view are polygonal in outline; (*c*) the leaf tissue is nearly centric and almost entirely formed by palisade tissue; (*d*) the outer limit of the bast is formed by massive isolated groups of bast fibers; (*e*) the medullary rays are broad and are as much as seven cells in breadth, and the medullary cells are elongated in a vertical direction; and (*f*) the end-walls of the vessels have simple perforations and the wood parenchyma has simple pits.

Recently Kariyone and Sato(1) reported that *Coriaria japonica* A. Gray, contains coriamyrtin, similar to the one isolated from *Coriaria myrtifolia.*

MATERIAL AND METHODS

The seeds and leaves used for this study were collected by the author last summer from plants growing in the city of Baguio and along the trail leading to Mount Santo Tomas. The fruits and leaves were preserved in 6 per cent solution of formalin. The study of the flowers was made from the dry specimen kept in the Bureau of Science and from the fresh material that was generously sent to the writer by Mr. Sixto Laraya, District Forester, stationed at Baguio.

The seeds are very minute and enclosed by a very hard pericarp, which serves as seed coat and makes sectioning quite difficult. This difficulty was remedied, however, by embedding them in a thick paste of gum arabic, which was subsequently exposed at room temperature until the consistency of the gum was suitable for sectioning. Several free-hand sections were made by using a gillette blade. The cross section through the blade was prepared by means of a sliding microtome, stained with safranin and contrasted with Delafield's hæmatoxylin and mounted in balsam.

DESCRIPTION

The plant.—This shrub was first described by J. Matsumura (3) from the specimen collected from Formosa as follows:

Coriaria intermedia, Matsumura, sp. nov. Frutex polygamo-monoicus, foliorum forma et magnitudine C. Japonicae, A. Gray, similis, antheris verruculosis, carpellis, versus latus reticulatis inter C. myrtifoliam, L. et C. nepalensem, Wall. mediatus. Racemi quam eas C. Japonicae, A. Gray. breviores, 50–90 mm. longi, aphylli, vel foliati. Sepala ovalia, margine purpures suffusa. Fl. steril. petala minutissima; stamina 10; antheris oblongo-ellipticis, verruculosis; vestigio germino mullo. Fl. fem; petala sepalis multo breviora, oblonga, acuta, intus carinata, stamina 10; carpella 5, petalis paulo breviora, matura vix 4 mm. longa, dosali unicostata, versus latus ventrale prominente venosa.

As to the identity of the Philippine *Coriaria*, Merrill (4) reported the following:

Luzon, Province of Benguet, Suyoc to Paui, (*4800 Merrill*), Nov. 7, 1905. In ravines at about 2,000 m. Formosa.

Specimens of the above number were sent to Dr. J. Matsumura of the Botanical Institute, Imperial University, Tokyo, Japan, for comparison with the type of his Formosan species, and after comparing the specimens, he expresses the opinion that the Luzon plant is identical with his *Coriaria intermedia*. Specimens collected in Benguet by Vidal, and recorded by him as "C. sp. (aff. *C. Japonica* A. Gray)" are undoubtedly referable to *Coriaria intermedia* Matsum. The thirteen known species of the genus have a peculiar geographical distribution extending from the Mediterranean region to the mountains of British India, Japan and Formosa and from New Guinea to New Zealand, Mexico and South America. The presence of this Formosan species in Benguet adds another very characteristic species to the known northern element in the Philippine flora.

The *Coriaria* from the Philippines as observed by the writer has the following features. It is a shrub from 1 to 3 meters high. The young branches are quadrangular and of a reddish or pinkish color with slightly elevated boatshaped lenticels. The leaves are from 2 to 4.2 centimeters in width and from 4 to 8.5 centimeters in length (Plate 1, fig. 1). They are sim-

ple, ovate-lanceolate, trinerved, glabrous and short petiolate with entire margin. The upper surface is dark green and the lower surface is light green or sometimes yellowish-green. The base varies from obtuse to rounded and the apex is acute or sometimes acuminate. The petiole is very short, from 1 to 2 millimeters long, nearly cylindrical with a shallow groove in the upper part. The midrib is prominently projecting on the lower side, at the base of which or directly from the upper end of the petiole two primary veins arise, one on each side, extended toward and close along the margin of the leaf and converging toward the apex. The flowers are arranged in simple racemes, from 6 to 15 centimeters long and they are provided with bracts (Plate 1, figs. 2, 3, and Plate 4, fig. 33 *a-c*). They are polygomo-monoecious, very minute, measuring about two millimeters in length, and are greenish in color tending to reddish or purplish coloring at the margin of the sepals, or appearing entirely red. The calyx consists of five persistent ovate sepals, concave in the inner part with acute or acuminate apex, two of which are slightly smaller in size; the petals are also five ovate, very minute, persistent, cream-white in color, with a prominent angular projection on the inner side (Plate 1, figs. 5, 8). During the maturation of the fruit, these petals develop unusually fast. They cover the cocci and become fleshy and are of a reddish color turning finally to bluish black, as represented on Plate 1, figures 10 and 14. The andrœcium of the sterile flower consists of 10 stamens, and that of the bisexual flower varies from 5 to 10. The anthers of the fully developed male flowers are oblong, verrucous, quadrilocular, introrse and purplish or reddish in color with long filaments (Plate 1, figs. 7, 9). They measure about 2.2 millimeters in length. The anthers of the bisexual flower vary from ovate to oblong-ovate or oblong, and usually are much smaller and have shorter filaments than those of the normal male flower. They measure from 0.7 millimeter to 1 millimeter in length (Plate 1, figs. 4 to 6, 8, 10, and 15). The gynæcium is composed of five more or less independent pistils, with filamentous reddish or purplish stigmas covered with papillose appendages (Plate 1, figs. 5, 8, 10). The fruit is composed of five very small crustaceous cocci, surrounded by fleshy persistent petals and sepals of a bluish-black color, which makes it berrylike in appearance (Plate 1, figs. 10, 13, and 14).

Structure of the leaf.—The transverse section of the leaf of Philippine *Coriaria* is bifacial. The blade is nearly uniform,

measuring about 0.25 millimeter. The upper epidermis is composed of a single layer of flattened or rectangular cells with very thick and highly cutinized outer cell walls. The lower epidermis also consists of a layer of cells of the same shape as the upper epidermal cells, but they are slightly thinner, their outer walls are less cutinized and some of them are modified into guard cells. The mesophyll is differentiated into palisade and spongy regions. The palisade chlorenchyma occupies about one-third of the mesophyll and consists of two layers of tubular cells arranged perpendicularly with distinct intercellular spaces. The palisade cells of the upper layer are longer than those of the lower one. They measure about 0.05 millimeter in length, whereas the lower palisade cells measure only about 0.03 millimeter. The spongy chlorenchyma region is made of parenchyma cells of various forms and sizes, but most are slightly elongated in the direction parallel to the surface of the leaf. It is richly supplied with air spaces. Plate 3, fig. 30, represents a transverse section through the midrib showing the character of the mesophyll described above. Calcium oxalate crystals and epidermal outgrowth are wanting.

In the surface section, the upper epidermal cells are polygonal in outline with from 5 to 7 straight thick walls. They are from 0.02 to 0.04 millimeter in length and from 0.015 to 0.03 millimeter in width and they are characterized by a fine, wavy striation that runs either parallel to the longer side of the epidermal walls or obliquely to the longest side of the epidermal wall. Plate 3, figure 31, is a small portion of the section prepared from the upper epidermis showing the surface view of the epidermal cells with the characteristic striations of their cuticle. Unlike the upper epidermis of *Coriaria myrtifolia* the stomata are wanting in the upper epidermis. The surface view of the lower epidermal cells is represented on the same plate, figure 32. The lower epidermal cells are also polygonal in outline measuring from 0.015 to 0.045 millimeter in length and from 0.01 to 0.03 millimeter in width, and are characterized by fine striations but their walls are thinner and vary from four to seven in number. The stomata are somewhat characteristic and numerous. They are not uniform in size and vary from 0.025 to 0.028 millimeter in length and from 0.012 to 0.015 millimeter in width. They are usually surrounded by four neighboring cells. Two of these neighboring cells limit the upper and lower ends of the stomata while the other two limit

the lateral sides and are applied parallel to the length of the guard cells. The first two are larger in size than the others.

The midrib is convex above and strongly convex below. The upper epidermis as well as the lower one consists of a single layer of cells, rectangular, or barrel-shaped, or nearly square in outline (Plate 3, fig. 30). The outer cell walls of the upper epidermis of the midrib as well as those of the upper epidermis of the blade are comparatively thicker than those of the lower epidermis. The collenchyma cells are poorly developed and as usual are found in two regions, one just in the inner side of the upper epidermis above the meristele and the other located within the lower epidermis below the meristele. The chlorenchyma cells in the upper region, as well as those of the lower region, consist of 3 to 4 layers of cells with more or less uniformly and slightly thickened walls. The cortical parenchyma located between the meristele and the lower collenchyma is composed of 4 to 6 layers of large polygonal isodiametric thin-walled cells, while the cortical parenchyma found in the inner part of the upper collenchyma region consists of three to seven layers of small polygonal thin-walled parenchyma cells.

The endodermis is somewhat conspicuous. It consists of a single layer of rectangular, square or polygonal, thin-walled parenchyma cells. Within this endodermis, the meristele is located. It is more or less lenticular in shape and the conducting tissue is somewhat plano-convex in outline. The upper part as well as the lower part is bounded by two groups of poorly developed sclerenchymatous cells. The walls of these cells are not much thickened nor highly lignified. The xylem region is limited on both the upper and lower part (nearly surrounded) by small and not distinctly differentiated phloem cells. It is made up mostly of xylem vessels, from 0.01 to 0.02 millimeter in diameter and wood parenchyma.

The seed.—The seed is campylotropous, exalbuminous and inclosed by a hard pericarp. It is kidney-shaped, laterally compressed, more rounded on one margin and the apex narrowly rounded (Plate 1, fig. 17 *a–c*). It measures from 2.2 to 3.2 millimeters in length, 1.6 to 2 millimeters in breadth and 1.2 to 1.5 millimeters in thickness. Externally it is brown in color and its surface is characterized by one prominent dorsal angular elevation or riblike structure that extends from the upper end of the hilum or micropylar to its lower or chalazal end, and two to four elevations or ribs on each lateral or flattened side. These ribs run parallel to the dorsal one and they are more or less

concentric to the hilum. They sometimes anastomose each other by a few transverse elevations that connect one with the other. The hilum is somewhat arrow-shaped with the narrow end toward the apex. The pericarp is hard, cutinized, and lignified. It takes the place of the outer seed coat or testa. The seed coat proper is only one and is very thin. The embryo is slightly bent and whitish in color. The hypocotil is short, conical, and measures about 0.4 to 0.6 millimeter in length. The cotyledons are fleshy, plano-convex, and sometimes they are slightly unequal in size. The plumule is inconspicuous.

Microscopical structure.—A diagrammatic representation of the transverse section of the coccus of *Coriaria intermedia* drawn under the camera lucida is indicated in Plate 1, fig. 18, showing the pericarp, the seed coat and a pair of cotyledons. The section is ovate in outline with a prominent angular protuberance at the upper part corresponding to the principal rib extended along the dorsal side of the coccus, it is more or less convoluted on the ventral side, corresponding to the section of the hilum, and is irregularly crenate or wavy on the lateral sides. The pericarp is differentiated distinctly into two regions, namely, the parenchymatous region and the stony region. The parenchymatous region corresponds to the exocarp and is made up of several layers of irregularly shaped parenchyma cells with slightly suberized cell walls which usually contain a brownish substance. In the outer part it is limited by a single layer of thick-walled cutinized and somewhat rectangular epidermal cells. The stony region is differentiated into two parts. The outer part, which corresponds to the mesocarp, is built up of obliquely or tangentially arranged elongated stone cells with very thick, lignified, and pitted cell walls. This portion is more definite on the lateral sides in which tangentially elongated sclerenchymatous elements conspicuously run parallel to the inner surface of the pericarp. The sclerenchymatous cells of the same region toward the dorsal sides, however, are mostly arranged obliquely, following the outline of the outer surface of the pericarp. At the region where the elevations or ribs, indicated above, are located groups of greatly elongated sclerenchymatous cells are observed. These sclerenchymatous cells in cross section appear polygonal in outline with from five to eight thick, lignified, and pitted cell walls with very much reduced cell cavity. They measure from 0.3 to 0.4 millimeter in length. The inner portion of this stony region, corresponding to the endocarp of a fleshy fruit, consists of radially elongated polygonal stone

cells with greatly thickened and highly lignified cell walls and with very much reduced cavities. Their walls are not distinctly striated. Plate 2, figs. 20, 21, and 22, show three different portions of the transverse section of the pericarp. In fig. 20, the sclerenchymatous tissue found in the region corresponding to the rounded elevation or rib is indicated and the stone cells of the middle portion of the stony region are seen tangentially elongated. Figure 21 shows a portion close to the dorsal region of the coccus, and fig. 22 illustrates the arrangement of the stone cells, which are found on the flattened sides of the pericarp.

The seed coat measures about 0.65 millimeter in thickness. In the outer part it is limited by a single layer of thin-walled empty parenchyma cells with a more or less rectangular outline. Their outer walls are wavy and brownish in color. In the surface view these cells appear polygonal in outline with wavy cell walls. Sometimes they are slightly elongated and their walls vary from four to six. Plate 2, fig. 24, shows a transverse section of the seed coat while fig. 25 on the same plate illustrates the characteristics of the surface view of the outer layer of cells of the seed coat. The inner part of the seed coat consists mostly of obliterated or considerably flattened parenchyma cells. Owing to the compactness of these cells their individual characteristic cannot be determined. These flattened cells are differentiated into two groups or regions. The walls of the cells in the outer region are brownish in color, while those in the inner region are colorless and hyaline. These two regions are sometimes separated by a row of tangentially elongated parenchyma cells with thin walls. Boat-shaped structures filled with protoplasm are often observed among the obliterated parenchyma cells in the innermost part of the seed coat.

The cotyledons in transverse section are plano-convex in outline. They are built up entirely of thin-walled parenchyma cells filled with aleurone grains or protein granules. In the outer part, they are surrounded by single thin-walled parenchyma cells of rectangular, barrel-shaped or polygonal outlines. The peripheral portion is occupied largely by radially elongated thin-walled parenchyma cells, and the middle portion by polygonal parenchyma cells. Plate 3, fig. 28, represents a segment taken from the convex or dorsal side of a cotyledon, showing the slightly elongated parenchyma cells. Figure 18, on same plate, illustrates a segment taken from the ventral or flat side of a cotyledon. This portion shows a greater elongation in the parenchyma on the inner side. In the tangential section, these

parenchyma cells appear more or less isodiametric in characteristic and they are polygonal in outline, as indicated on Plate 3, fig. 27. Plate 2, fig. 26, represents a median section of a cotyledon cut parallel to its flat surface showing a group of small elongated parenchyma cells, which initiate the formation of the conducting tissue.

When the seeds are subjected to Schultz's maceration process, the conspicuous type of cell observed under the microscope is indicated on Plate 2, fig. 23, *a* and *b*. The stone cells derived from the stony region display a great diversity of forms and sizes. They vary from 0.01 to 0.06 millimeter in length. They are either elliptical ovate, oblong, elongated, tapering at both ends, straight or bent at one side, crooked or irregularly shaped cells. Their walls are prominently pitted but not distinctly striated and their cavities are very much reduced. The long sclerenchymatous elements are numerous, and they are either straight or crooked and taper at both ends.

SUMMARY

1. The leaf in cross section is bifacial. The upper and lower epidermis consist of a single layer of cells with very thick and highly cutinized outer cell walls. The mesophyll is thin and composed of two rows of palisade chlorenchyma in the upper part and spongy chlorenchyma in the lower part.

2. The stomata are located on the lower surface only and are characterized by the parallel arrangement of the two small subsidiary cells to the pore. Epidermal outgrowth and calcium oxalate are wanting.

3. In the surface preparation, both the upper and the lower epidermal cells are polygonal in outline with fine wavy striations.

4. The midrib in cross section exhibits poorly developed collenchyma and sclerenchymatous cells. The endodermis is distinct and the phloem cells are found surrounding the water conducting tissue.

5. The seed is campylotropous, exalbuminous and inclosed by the adhering pericarp. Externally, it is brown to dark brown in color and characterized by the presence of riblike structure elevations found at the dorsal and lateral sides.

6. The pericarp is hard and differentiated into two regions; namely, the parenchymatous region and the stony region. The seed coat is only one and very thin.

7. The embryo is small, slightly bent, and whitish in color. The hypocotil is short and conical. The cotyledons are plano-convex in outline, consisting of thin-walled parenchyma cells richly supplied with protein granules and the plumule is inconspicuous.

BIBLIOGRAPHY

1. KARIYONE, T., and T. SATO. Coriaria japonica A Gray. Chem. Zentralbl. 101, 1 (1930) 3317.
2. LINDSAY, W. L. On the toot-poison of New Zealand. Journ. Bot. 1 (1863) 247–50.
3. MATSUMURA, J. Notes on Liuku and Formosan plants. Bot. Mag. 12 (1898) 62.
4. MERRILL, E. D. New or noteworthy Philippine plants, V. Philip. Journ. Sci. 1 (Supplement) (1906) 205–6.
5. REUTTER, L. Traité Matiére Médicale (1923) 275–6.
6. SOLEREDER, H. Solereder's Systematic Anatomy of the Dicotyledons, (Engl. Ed. Boodle and Fritsch) 1 (1908) 249.
7. WELLS, A. H. The physiological active constituents of certain Philippine medicinal plants, III. Philip. Journ. Sci. 14 (1919) 1–7.

ILLUSTRATIONS

[The microscopical drawings and sketches of some of the flowers were prepared by the author, except figs. 20 and 30 which were drawn by Miss Teodora Kalalo, assistant instructor, Department of Botany, University of the Philippines. The habit sketches, including the sketches of some of the flowers, fruit, and seeds, are by Mr. Macario Ligaya, Bureau of Science.]

PLATE 1. CORIARIA INTERMEDIA MATSUMURA

FIG. 1. A small portion of the plant showing the arrangement and character of the leaves and fruit; × 0.5.

2. A raceme of young bisexual flowers showing the bracts and their characteristic filamentous stigma; × 2.5.
3. A portion of a receme of young male or sterile flowers; × 3.
4. A single bisexual flower after fertilization; × 8.
5. A young bisexual flower partially dissected to show the relative position between sepals *s*, petals *p*, the pistil and the stamen drawn from a fresh flower; × 8.
6. A single bisexual flower showing the relative positions of the stamens and stigmas; × 8.
7. A fully developed male flower with ten stamens with long filaments, *s*, sepals, and *p*, petals; × 8.
8. A longitudinal floral diagram of a young bisexual flower showing the relative position between the sepals, petals, and pistils.
9. A young male or sterile flower showing the arrangement of the anthers; × 8.
10. A semi-diagrammatic drawing of a mature bisexual flower. *s*, sepals, *p*, petals.
11. A floral diagram of the cross section of a sterile or male flower.
12. A floral diagram of the cross section of a bisexual or perfect flower.
13. A semi-diagrammatic drawing of a cross section of a nearly mature fruit, *s*, sepals, and *p*, petals.
14. A mature fruit; × 2.5.
15. *a–e*, A group of anthers dissected from a bisexual flower; × 12.
16. Normal stamens from a male flower. *a*, ventral view and *b*, dorsal view; × 12.
17. The mature coccus drawn in three positions, *a*, dorsal side, *b*, lateral side, and *c*, ventral side; × 6.
18. A diagrammatic representation of the transverse section of a coccus. *scl*, sclerenchyma, *p*, parenchyma, and *co*, cotyledon and *h*, xylem; × 16.
19. A lateral view of the embryo with one cotyledon removed. *r*, radicle, and *co*, cotyledon; × 16.

PLATE 2. CORIARIA INTERMEDIA MATSUMURA

FIG. 20. A segment of the transverse section of the pericarp taken from the lateral part near the region of a rib. *scl*, sclerenchyma, *sc*, stone cells, and *p*, parenchyma; × 275.

21. Another segment of a transverse section from the lateral part of the pericarp, *e*, epidermis, *p*, parenchyma, *scl*, sclerenchyma, *sc*, stone cells; × 275.

22. A segment of the transverse section near the dorsal side of the pericarp showing the greatly tangentially arranged sclerenchyma cells, *scl;* and the stone cells, *sc;* ×275.

23. A group of isolated cells from the pericarp, *a*, sclerenchyma cells, × 165; and *b*, stone cells; × 450.

24. A segment of a transverse section of the seed coat. *op*, outer obliterated parenchyma with brown coloration. op_2, obliterated parenchyma without brown colorations; × 275.

25. A segment of the surface view of the outer part of the seed coat; × 275.

26. A longitudinal section of the cotyledon showing the elongated parenchyma cells, which initiate the development of the conducting tissue; × 275.

PLATE 3. CORIARIA INTERMEDIA MATSUMURA

FIG. 27. A tangential section of the cotyledon showing the polygonal outline of the parenchyma cells containing protein granules; × 275.

28. A segment of the transverse section of the cotyledon through the dorsal side showing the epidermis and the slight radial elongation of the parenchyma cells containing protein granules; × 275.

29. A transverse section of the cotyledon through the ventral side showing the radial elongation of the parenchyma cells containing protein granules; × 275.

30. A transverse section of a leaf through the midrib. *c*, collenchyma, *en*, endodermis, *scl*, sclerenchyma, *ph*, phloëm, and *x*, xylem; × 125.

31. A segment of the surface preparation of the upper epidermis showing a fine striation; × 450.

32. A surface view of a segment prepared from the lower epidermis showing the stomata and the characteristic fine striation of the cuticle; × 450.

PLATE 4. CORIARIA INTERMEDIA MATSUMURA

FIG. 33, *a–c*. Photograph of the portions of the fresh leafless branches showing the arrangement of unisexual and bisexual flowers.

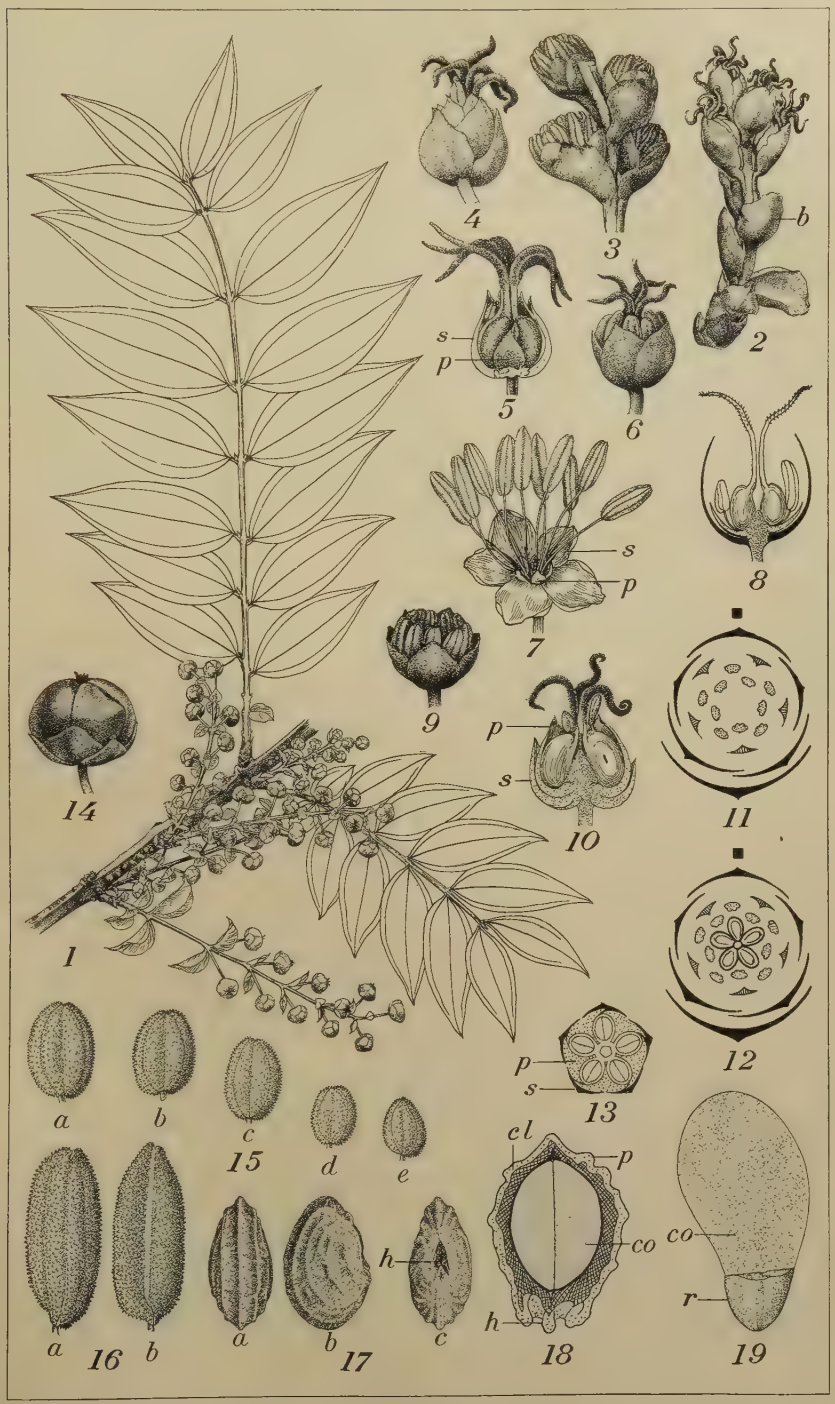
4
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PLATE 1.

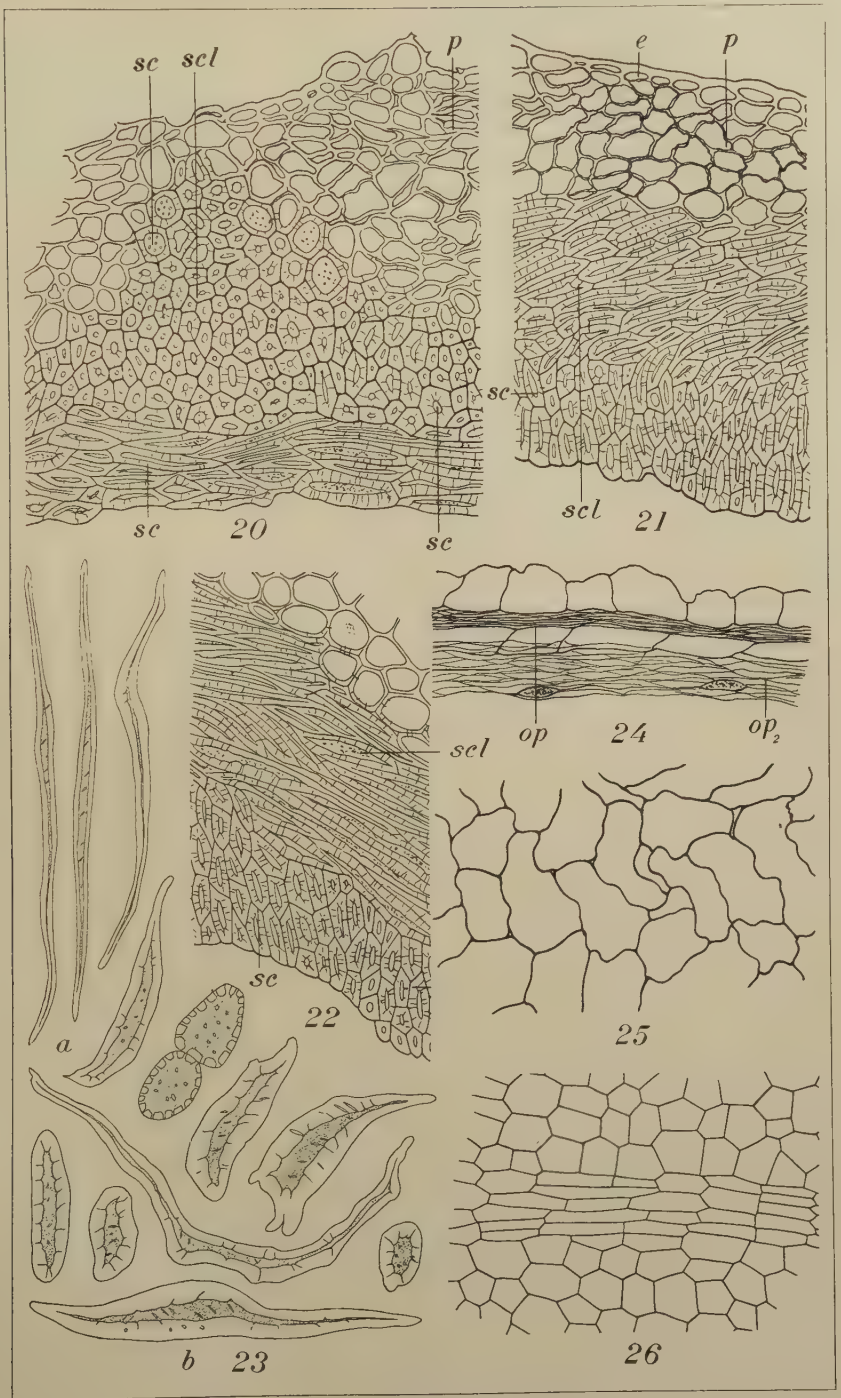

PLATE 2.

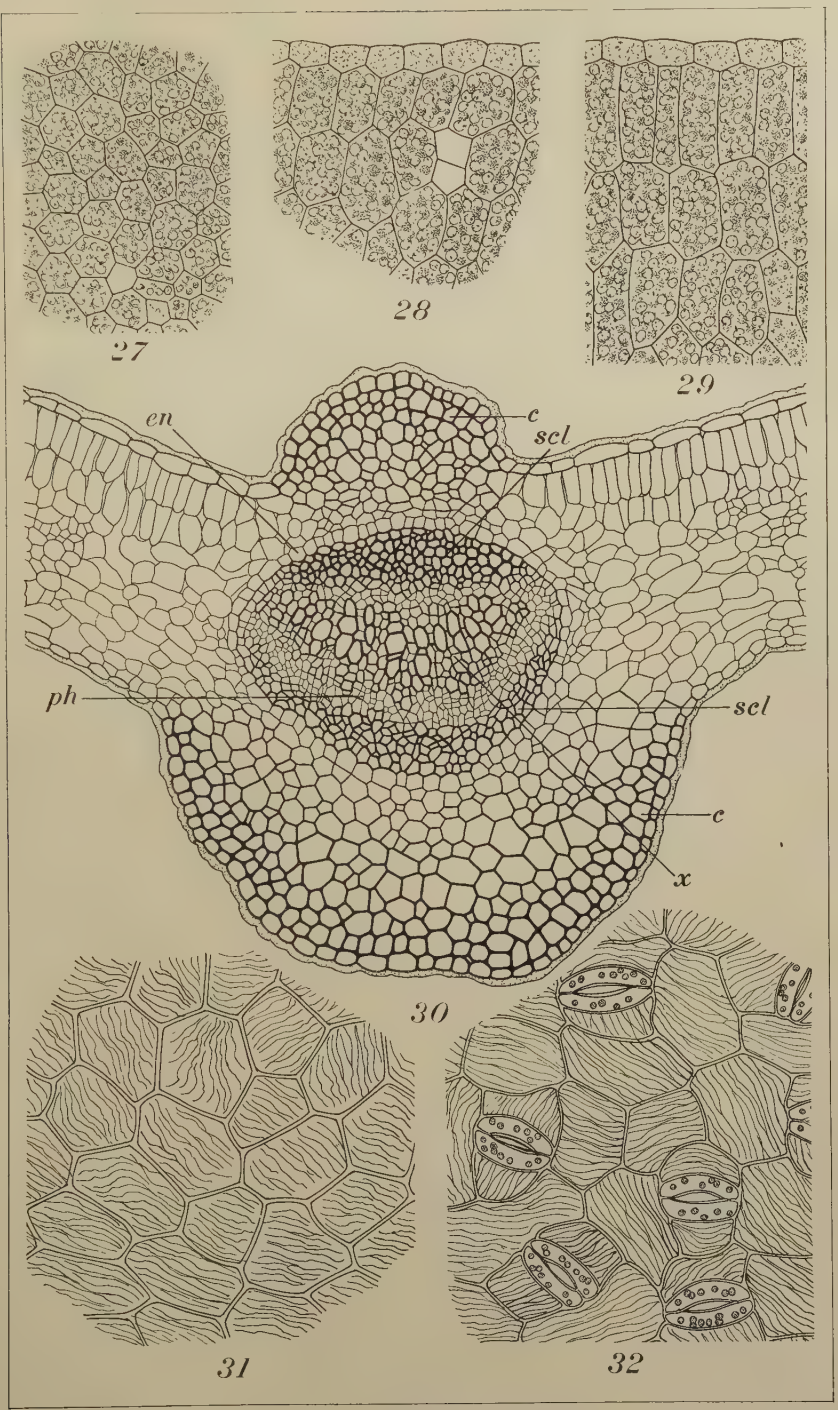

PLATE 3.

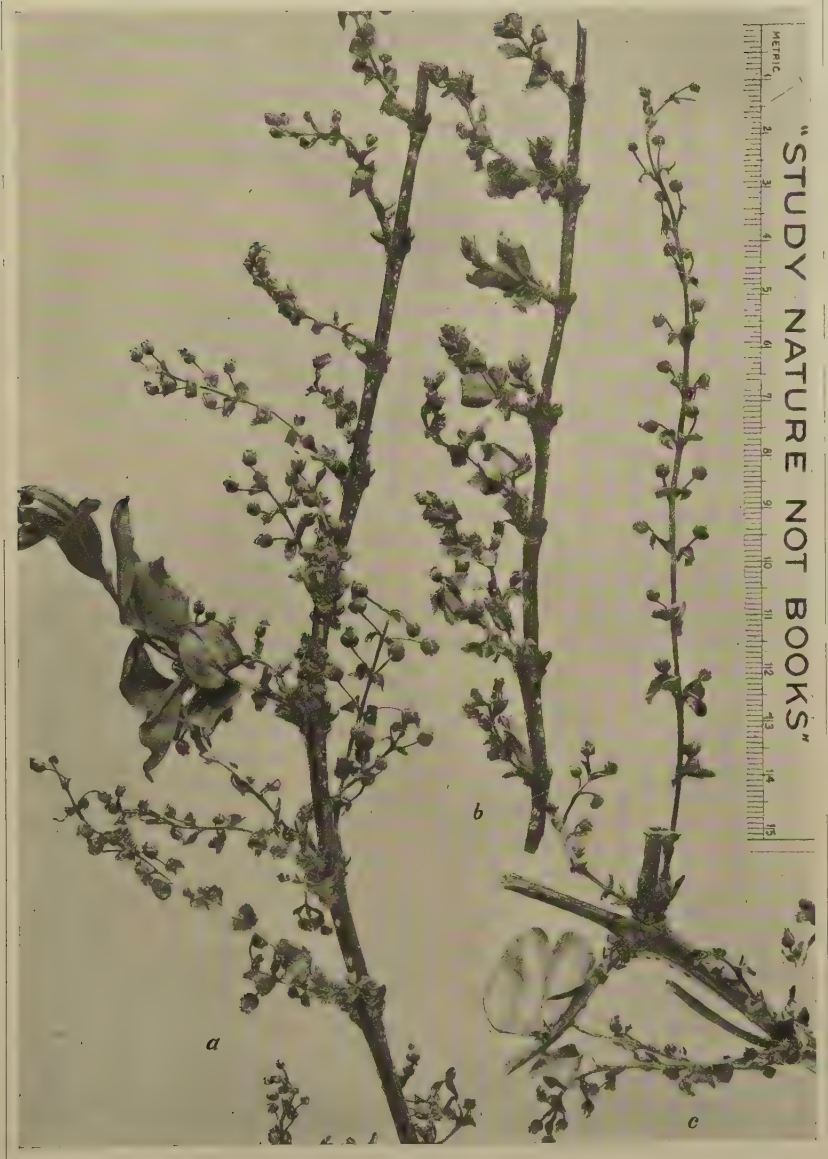

PLATE 4.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM THE PHILIPPINES (DIPTERA), XI[1]

By CHARLES P. ALEXANDER

Of Amherst, Massachusetts

THREE PLATES

The very interesting crane flies discussed herewith were taken in various parts of Luzon by my friends Messrs. McGregor, Duyag, and Rivera, and in Minadanao by my former student at this college Mr. Charles F. Clagg. I wish to thank these gentlemen for their continued kindly interest in making known this fauna.

TIPULINÆ

Genus DOLICHOPEZA Curtis

Dolichopeza CURTIS, Brit. Entomol. (1825) 62.

I must consider several groups that are allied to *Dolichopeza* and have hitherto been maintained as distinct genera as representing no more than subgeneric aggregations. Such subgenera are as follows:

Dolichopeza, s. s., is found in the western Palæarctic and eastern Nearctic Regions, with the vast majority of the species occurring in Australia and New Zealand. Curiously enough, with the above distribution, no species is found in the Chilean Subregion of the Neotropics. A few aberrant species that may be found to be incorrectly placed herein, including *isolata* Alexander (Luzon), are found in the Oriental and Ethiopian Regions.

Nesopeza Alexander is the dominant subgenus in the Oriental and eastern Palæarctic Regions. The typical group (*gracilis* and allies) has Rs very long and the wings handsomely patterned. Edwards is inclined to restrict the subgeneric name to this latter group, leaving the equally or more abundant species with plain wings and Rs of a shorter length in the typical subgenus.

[1] Contribution from the entomological laboratory, Massachusetts Agricultural College.

Mitopeza Edwards includes five species, of which one is described herewith from Luzon. All the known species are from the Oriental Region. The typical form, having macrotrichia in the distal cells of the wing, with very blunt unchitinized cerci, and with a very remarkable condition of the spermothecal ducts in the female, is very distinct. However, *longicornis* Brunetti lacks the macrotrichia and has the spermothecal ducts reduced in number and size. This reduction is carried still further in *rizalensis* sp. nov. The Bornean *mjöbergi* Edwards has a very distinct and peculiar venation (Plate 1, fig. 4).

Oropeza Needham has about a score of species that are nearly evenly distributed in the eastern Nearctic and eastern Palæarctic Regions.

Trichodolichopeza Alexander, as known, is entirely Ethiopian, with the majority of the species occurring in South Africa.

Megistomastix Alexander is represented only by two species in the Greater Antilles of the Neotropical Region.

These subgeneric groups may be separated by means of the following key:

1. Apical cells of wings with macrotrichia ..... 2.
   Apical cells of wing without macrotrichia ..... 4.
2. Cell 1st M_2 closed ..... 3.
   Cell 1st M_2 open by atrophy of basal section of M_3.
   Trichodolichopeza Alexander.
3. Rs short, transverse, not exceeding one-half R_{2+3}; Sc_2 ending opposite origin of Rs; m-cu connecting with M_{3+4} at or close to fork, always beyond the fork of M ..... *Megistomastix* Alexander.
   Rs long, exceeding one-half R_{2+3}, Sc_2 nearly opposite its fork; m-cu connecting with M far before its fork, at the fork in *nigromaculata* Edwards ..... *Mitopeza* Edwards (in part) (*nitidirostris* et al.).
4. Cell 1st M_2 closed ..... 5.
   Cell 1st M_2 open by atrophy of basal section of M_3 ..... 6.
5. Rs short, Sc_2 ending opposite or just beyond its origin; m-cu beyond fork of M ..... *Oropeza* Needham.
   Rs long, subequal to or nearly as long as R_{2+3} Sc_2 ending nearly opposite its fork; m-cu far before fork of M.
   Mitopeza Edwards (in part) (*longicornis*).
6. Rs short, transverse, Sc_2 opposite or close to its origin.
   Dolichopeza Curtis.
   Rs longer, subequal to or longer than R_{2+3}, Sc_2 ending beyond mid-length ..... 7.
7. Branches of medial field regularly pectinate, r-m connecting posteriorly with the basal section of M_{1+2} (Plate 1, fig. 3) .... *Nesopeza* Alexander.
   Branches of medial field not pectinate, r-m connecting with M_1 some distance beyond origin (Plate 1, fig. 4).
   Mitopeza Edwards (in part) (*mjöbergi*).

Scamboneura Osten Sacken might also be construed as falling within the limits of *Dolichopeza,* but I would believe that it represents a separate branch of the Dolichopezaria.

DOLICHOPEZA (MITOPEZA) RIZALENSIS sp. nov. Plate 1, fig. 1; Plate 2, fig. 23.

General coloration dark brown; legs with the tips of the tibiæ and all tarsi snowy white; wings grayish subhyaline, with a heavy dark brown pattern in the costal and apical portions; sparse macrotrichia in cells of wing at apex.

Male.—Length, about 8 millimeters; wing, 10.5; antenna, about 4.5.

Female.—Length, about 9 millimeters; wing, 10 to 11.

Rostrum brownish yellow; palpi black. Antennæ (male) a little more than one-half the length of body; basal segments testaceous, beyond the first flagellar passing into black; flagellar segments long-cylindrical, with a delicate erect pubescence and a group of three or four relatively short verticils at base on outer face of segments, these much shorter than the segments alone. Head blackish, sparsely pruinose behind on sides, the front yellowish.

Mesonotal præscutum dark brown, with indications of four dark reddish brown stripes; posterior sclerites of mesonotum more uniformly brown. Pleura testaceous brown. Halteres elongate, dark brown, the extreme base of stem pale yellow. Legs with the coxæ and trochanters testaceous yellow; femora dark brown, paler basally; tibiæ brown at base, the tips narrowly snowy white; tarsi snowy white. In the male the tibiæ are chiefly white, the basal third more darkened. Wings (Plate 1, fig. 1) grayish subhyaline, heavily patterned in costal and apical portions with dark brown; cells C and Sc dark, the bases paler; radial field heavily darkened, especially in female, with conspicuous whitish spots before and beyond the stigma; cord and veins beyond it seamed with brown. Sparse macrotrichia in outer ends of cells R_3 to 2d M_2, inclusive. Venation: Rs subequal to or longer than R_{2+3}; cell 1st M_2 relatively small.

Abdominal segments chiefly blackened, especially on posterior portion, the base laterally brightening to obscure yellow; hypopygium dark. Male hypopygium (Plate 2, fig. 23) with the tergite, 9*t,* trifid, the pale cushionlike median lobe projecting caudad beyond the level of the laterals, densely clothed with microscopic erect setulæ; lateral lobes with less numerous coarse setæ. Outer dististlyle, *od,* profoundly bifid. Inner dististyle, *id,* very irregular in outline.

Ovipositor with blunt fleshy lobes; spermothecal ducts relatively few.

LUZON, Rizal Province, Novaliches, August 8 and 9, 1930 (*A. C. Duyag*); holotype, male; allotype, female; paratypes, 1 male and 1 female.

Dolichopeza (*Mitopeza*) *rizalensis* agrees with the subgenotype, *D.* (*M.*) *nitidirostris* (Edwards), and the more recently described *D.* (*M.*) *nigromaculata* (Edwards) in the presence of macrotrichia of the apical cells of the wing, differing from both in the snowy-white tarsi and tibial apices. In the latter character, the present species agrees with *D.* (*M.*) *longicornis* (Brunetti), which differs in having no macrotrichia in apical cells of wing and with the male antennæ longer than the entire body. The following key will suffice to separate the known species of *Mitopeza:*

1. Cell 1st M_2 open by the atrophy of the basal section of M_3 (Borneo). *mjöbergi* (Edwards).
   Cell 1st M_2 closed ..... 2.
2. Apical cells of wing without macrotrichia (Assam). *longicornis* (Brunetti).
   Distinct though sparse macrotrichia in apical cells of wing..... 3.
3. Legs black ..... 4.
   Legs with the tarsi and tips of tibiæ extensively whitened (Luzon). *rizalensis* sp. nov.
4. Head blackish; præscutum with four velvety-black spots, one pair in humeral region, the other before the wings; m-cu at fork of M (Perak) ..... *nigromaculata* (Edwards).
   Head dark brown; thorax dark brown, the præscutum with indications of three darker stripes; m-cu far before fork of M (Kedah). *nitidirostris* (Edwards).

DOLICHOPEZA (NESOPEZA) MELANOSTERNA sp. nov. Plate 1, fig. 2; Plate 2, fig. 24.

Male.—Length, about 8 to 9 millimeters; wing, 9.5 to 11.

Female.—Length, about 11 millimeters; wing, 11.

Generally similar and allied to *D.* (*N.*) *angustaxillaris* Alexander (Luzon), differing especially in the larger size, details of venation, as the deeper forks of M, the much darker coloration, including the entirely blackened eighth sternite, and the structure of the male hypopygium, especially the ninth tergite.

Antennæ longer than in *angustaxillaris*, the flagellar segments correspondingly lengthened. Mesonotum dark brown, the pleura pale, the dorsopleural region darkened; ventral sternopleurite, meron, and anepisternum with darkened areas. Legs with the white proximal ends of fore basitarsi narrow, of the mid basitarsi obsolete or with a mere genual brightening. Wings

(Plate 1, fig. 2) strongly tinged with blackish; medial forks deep. Abdominal tergites chiefly blackened, with a narrow transverse yellow annulus on basal half; hypopygium black, including the entire eighth sternite. Male hypopygium (Plate 2, fig. 24) with the tergite, 9*t*, blackened, the lateral lobes broad, simple, their ventral margins heavily blackened and microscopically toothed; median lobe small, acute. Outer dististyle, *od*, shorter and stouter than in *angustaxillaris*.

LUZON, Laguna Province, Ube, February 3 to 12, 1930 (*F. Rivera*); holotype, male; allotype, female; paratypes, 8 males.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) BILOBULIFERA sp. nov. Plate 1, fig. 5; Plate 2, fig. 25.

General coloration pale ocherous, with a conspicuous black dorsal stripe on pleura; knobs of halteres infuscated; legs chiefly yellow, the femoral tips insensibly darkened; wings whitish subhyaline, the small stigma circular in outline; cell 1st M_2 long; male hypopygium with the outer dististyle a small, hairy, bilobed structure; inner style with the body small, produced into a long ribbonlike portion.

Male.—Length, about 4.2 to 4.4 millimeters; wing, 5 to 5.3.

Rostrum reddish brown; palpi a little darker. Antennæ black, the outer segments paling to brown; relatively elongate for a member of this genus, if bent backward extending nearly to the wing root; flagellar segments passing through oval to cylindrical, the verticils of the outer segments shorter than the segments alone; terminal segment elongate, about one-half longer than the penultimate. Head blackish, sparsely pruinose; eyes (male) contiguous on vertex or nearly so, the ommatidia coarse.

Mesonotum pale ocherous, scarcely variegated with darker, the scutellum and median area of scutum more testaceous. Pleura pale yellow, with a broad blackish dorsolongitudinal stripe. Halteres pale, the knobs infuscated. Legs with the coxæ and trochanters yellow; femora yellow, the tips insensibly darker; tibiæ and tarsi obscure yellow, the terminal tarsal segments infuscated; claws elongate, with a long conspicuous spine at near one-third the length. Wings (Plate 1, fig. 5) whitish subhyaline, the prearcular and costal regions more yellowish; stigma brown, circular; veins dark brown, paler in the flavous areas. Venation: Sc_1 ending about opposite two-thirds the length of the long arcuated Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 unusually long, the second

section of M_{1+2} being equal to the third section; basal section of M_3 longer than m, gently arcuated; m-cu at fork of M; vein 2d A at origin converging toward 1st A, the cell relatively long and narrow.

Abdominal segments bicolorous, dark brown, the caudal margins of the individual segments narrowly obscure yellow; hypopygium chiefly yellow, the basistyles conspicuously dark brown. Male hypopygium (Plate 2, fig. 25) with the basistyles, *b*, covered with short dense setulæ, in addition to scattered major setæ; ventromesal lobe, *b*, large, flattened, basal in position, weakly bilobed at apex. Two dististyles, the outer, *dd*, a small, unequally bilobed hairy structure; inner style, *vd*, with the base a trifle enlarged, thence long-produced into a slender blade, the inner margin before midlength with a small pale spinous point. Gonapophyses, *g*, with the mesal-apical lobe elongate, slender, transversely ribbed.

LUZON, Laguna Province, Ube, February 3, 1930 (*F. Rivera*); holotype, male; paratype, male.

Limonia (*Limonia*) *bilobulifera* is very different from the other regional species in the structure of the male hypopygium.

LIMONIA (LIMONIA) MELANOPLEURA sp. nov. Plate 1, fig. 6; Plate 2, fig. 26.

General coloration brownish black, including most of the thoracic pleura; halteres and legs brownish black; claws simple; wings with a strong blackish tinge, the circular stigma darker; Sc_1 ending about opposite midlength Rs, Sc_2 at its tip; male hypopygium with the ventromesal lobe of basistyle very large and stout; ventral dististyle small, setiferous, produced into a long slender rostral prolongation, without spines.

Male.—Length, about 3.5 millimeters; wing, 4.2.

Female.—Length, about 5 millimeters; wing, 4.8.

Rostrum and palpi black. Antennæ black throughout; flagellar segments (male) oval, the longest verticils slightly exceeding the segments and unilaterally arranged; the female has the segments short-oval. Head black, sparsely pruinose; eyes of both sexes contiguous or nearly so, at most separated by a capillary strip of anterior vertex.

Mesonotum brownish black. Pleura chiefly black, the ventral sternopleurite and dorsopleural region paler, testaceous brown. Halteres brownish black, the extreme base of stem pale. Legs with the coxæ brownish testaceous, the trochanters somewhat paler; remainder of legs brownish black; claws small, without distinct spines. Wings (Plate 1, fig. 6) with a strong

blackish tinge, the circular stigma darker brown; veins dark brown. Venation: Sc_1 ending about opposite midlength of Rs, Sc_2 at its tip; free tip of Sc_2 slightly proximad of R_2; m-cu just before the fork of M; vein 2d A long, converging toward 1st A at origin.

Abdomen, including the hypopygium, black. Male hypopygium (Plate 2, fig. 26) with the tergite, 9*t*, unusually extensive, broad at base, strongly narrowed outwardly, the two low lobes separated by a small emargination; a submarginal series of about six strong setæ on either side. Basistyle, *b*, relatively long and slender, the ventromesal lobe very stout, occupying almost the entire mesal face of the style. Ventral dististyle, *vd*, a small oval lobe with long conspicuous setæ, the rostral prolongation long, slender, only gently curved, with no developed spines.

LUZON, Laguna Province, Ube, April 14, 1930 (*R. C. McGregor*); holotype, male; allotype, female.

Limonia (*Limonia*) *melanopleura* is well-distinguished by the small size, very extensive black coloration, and the structure of the male hypopygium. I cannot indicate any closely allied regional species.

LIMONIA (LIMONIA) TREMULA sp. nov. Plate 1, fig. 7.

General coloration of mesonotal præscutum brown, variegated with sublateral and a posterior median yellow stripe; pleura yellow, with a conspicuous longitudinal dark stripe; halteres dusky; legs yellow; wings grayish yellow, with a restricted brown pattern; Rs angulated and weakly spurred at origin; m-cu about one-half its length beyond the fork of M; abdomen brownish black, the segments narrowly ringed caudally with yellow.

Female.—Length, about 5.5 millimeters; wing, 6.3.

Mouth parts small, the rostrum reddish brown; palpi black. Antennæ black throughout; basal flagellar segments subglobular to short-oval, the outer segments more elongate; segments with two conspicuous verticils on outer face, unilaterally arranged. Head fulvous brown, the center of the vertex extensively darkened.

Pronotum brown. Mesonotal præscutum brown, variegated with brownish yellow, the latter including sublateral stripes that meet in front and a median stripe on posterior half of sclerite; the darkened portions include the lateral margins to the anterior region and submedian stripes that become approximated in front, behind crossing the suture onto the scutal lobes; median region

of scutum and scutellum obscure yellow, the latter with each lateral third darkened; postnotal mediotergite testaceous brown, more yellowish laterally and on the dorsal half of the pleurotergite. Pleura obscure yellow, with a conspicuous dorsolongitudinal dark stripe that extends to the abdomen, including the ventral half of the pleurotergite; ventral sternopleurite a little darkened. Halteres dusky, the base of stem restrictedly pale. Legs with the coxæ yellow, the fore coxæ a trifle darkened; trochanters yellow; remainder of legs obscure yellow, the femoral tips rather broadly but insensibly clearer yellow; terminal tarsal segments a trifle darkened; claws relatively slender, with a basal tooth that is further prolonged into a slender seta. Wings (Plate 1, fig. 7) grayish yellow, with a restricted and relatively diffuse brown pattern, including the stigma, cord, and outer end of cell 1st M_2; origin of Rs and fork of Sc; basal portion of wing and costal region a little darkened; veins cream-colored, a little darkened in the clouded areas. Macrotrichia of veins relatively long and conspicuous, including Rs except on its basal section. Venation: Sc_1 ending about opposite three-fifths the length of Rs, Sc_2 at its tip; Rs angulated and weakly spurred at origin; free tip of Sc_2 and R_2 in approximate transverse alignment; cell 1st M_2 large, subrectangular, a little longer than vein M_3 beyond it; m-cu about one-half its length beyond the fork of M, subequal to the distal section of Cu_1; vein 2d A strongly sinuous, at origin parallel to vein 1st A or nearly so.

Abdomen brownish black, the segments narrowly ringed caudally with yellow; genital segments ocherous. Ovipositor with the tergal valves slender, gently upcurved, reddish horn color; sternal valves large, straight, conspicuously blackened at base.

LUZON, Laguna Province, Ube, February, 1930 (*F. Rivera*); holotype, female.

Limonia (*Limonia*) *tremula* is amply distinct from described regional species, agreeing in some respects with *L.* (*L.*) *luteivittata* Alexander, but differing in all details of coloration and venation.

LIMONIA (LIBNOTES) UNISTRIOLATA sp. nov. Plate 1, fig. 8; Plate 2, fig. 27.

General coloration of mesonotal præscutum obscure yellow, with a single complete black stripe, on either side behind bordered by clear golden yellow; rostrum, palpi, antennæ, knobs of halteres and legs black; wings with a faint brown suffusion; Sc_1 long; Rs angulated at origin; cell 1st M_2 small, rectangular, less than one-half the distal section of M_{1+2}; anal veins gently diver-

gent; male hypopygium with the ventral dististyle large and fleshy, the rostral prolongation with two very unequal spines.

Male.—Length, about 6 millimeters; wing, 6.8.

Female.—Length, about 6.3 millimeters; wing, 7.

Rostrum and palpi black. Antennæ black throughout; flagellar segments subcylindrical, becoming longer outwardly; verticils of basal segments slightly exceeding the segments; terminal segment pointed at apex, about one-half longer than the penultimate. Head black, sparsely pruinose, the anterior vertex more silvery, reduced to a narrow strip.

Pronotum black, the anterior lateral pretergites yellow. Mesonotal præscutum obscure yellow, with a single broad and complete black stripe, on either side on posterior two-thirds clear golden yellow; lateral portions of sclerite weakly infumed; scutal lobes black; median region of scutum paler; scutellum and postnotal mediotergite blackened. Pleura chiefly brown, the posterior dorsopleural region and the ventral sternopleurite obscure yellow. Halteres pale, the knobs dark brown. Legs with the fore coxæ infuscated, the remaining coxæ and all trochanters yellow; remainder of legs dark brown, only the femoral bases restrictedly pale. Wings (Plate 1, fig. 8) with a faint brown suffusion, the circular stigma a trifle darker; veins pale brown. Venation: Sc_1 ending opposite r-m, Sc_2 far from its tip, Sc_2 about opposite midlength of the angulated Rs; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 relatively small, less than half the distal section of vein M_{1+2}; m and basal section of M_3 subequal, straight, in approximate transverse alignment; m-cu at one-third the length of cell 1st M_2; anal veins parallel to gently divergent at origin.

Abdomen dark brown, the sternites obscure yellow; hypopygium dark. Male hypopygium (Plate 2, fig. 27) with the tergite, 9*t*, extensive, the caudal margin with a deep V-shaped notch, the lateral lobes with coarse setæ. Basistyle, *b*, relatively small. Ventral dististyle, *vd*, a large fleshy lobe, the rostral prolongation with two unequal gently curved spines. Dorsal dististyle a strongly curved hook, the tip acute. Gonapophyses, *g*, with the concave margin of the mesal-apical lobe with minute points.

Luzon, Mountain Province, Ifugao Subprovince, Huungduan, April 5, 1930 (*F. Rivera*); holotype, male; allotype, female.

Allied to species such as *L.* (*L.*) *neofamiliaris* Alexander and *L.* (*L.*) *subfamiliaris* Alexander, likewise from Luzon, differing conspicuously in the coloration and details of structure of the male hypopygium.

LIMONIA (LIBNOTES) MELANCHOLICA sp. nov. Plate 1, fig. 9; Plate 2, fig. 28.

General coloration polished black; rostrum, palpi, antennæ, knobs of halteres, and legs blackened; wings with a faint dusky tinge, cells C and Sc darker; Sc_1 ending some distance beyond r-m, Sc_2 opposite the fork of Rs; cell 1st M_2 rectangular, less than one-half vein M_{1+2} beyond it; m and basal section of M_3 in nearly transverse alignment; m-cu at about one-fourth to one-fifth the length of cell 1st M_2; anal veins gently divergent; male hypopygium with the ventral dististyle large and fleshy, the rostral prolongation with two straight spines of unequal diameter.

Male.—Length, about 5.5 to 7 millimeters; wing, 6 to 7.

Female.—Length, about 6.5 to 6.8 millimeters; wing, 6.5.

Rostrum, palpi, and antennæ black; flagellar segments oval, becoming more elongate outwardly; longest verticils exceeding the segments in length and unilaterally arranged. Head black, heavily dark gray pruinose; anterior vertex narrow, light gray.

Pronotum black. Mesonotum polished black, the median region of scutum obscure yellow. Pleura chiefly black, the propleura, dorsal pteropleurite, and dorsopleural membrane brownish yellow. Halteres yellow, the knobs dark brown. Legs with the fore and hind coxæ yellow, the mid-coxæ slightly darkened; all trochanters yellow; remainder of legs brownish black, the femoral bases restrictedly pale; claws relatively long and slender, with an acute subbasal tooth, with additional microscopic basal denticles. Wings (Plate 1, fig. 9) with a faint dusky tinge, cells C and Sc more infumed; wing tip and posterior margin to vein Cu slightly clouded; a dark seam along vein Cu; stigma subcircular in outline, slightly darker than the ground color; veins dark brown. Venation: Sc_1 ending some distance beyond r-m, Sc_2 opposite the fork of Rs, Sc_1 a little longer than m-cu; free tip of Sc_2 and R_2 in approximate transverse alignment; cell 1st M_2 rectangular, less than one-half vein M_{1+2} beyond it; m and basal section of M_3 in nearly transverse alignment; m-cu at from one-fourth to one-fifth the length of cell 1st M_2; anal veins gently divergent.

Abdomen black, the sternites brown; genitalia of both sexes darkened. Male hypopygium (Plate 2, fig. 28) with the caudal emargination of the tergite, 9*t*, broadly V-shaped; marginal setæ of lobes strong and powerful; a group of about three small median setæ. Ventral dististyle, *vd*, large and fleshy, the rostral prolongation with two nearly straight spines, of nearly equal length but unequal diameter, the inner slender to setiform; setæ

of apex of prolongation relatively sparse. Dorsal dististyle a chitinized sickle, sinuously to subangularly bent, the long acute tip slightly decurved. Gonapophyses, *g*, with the apex of each slightly blackened, the surface and margin before tip with erect pale points.

LUZON, Tayabas Province, Candelaria, near town, alongside a small stream, June 20 to 25, 1930 (*McGregor and Rivera*); holotype, male; allotype, female; paratypes, 5 of both sexes.

Limonia (*Libnotes*) *melancholica* is allied to *L.* (*L.*) *neofamiliaris* Alexander and *L.* (*L.*) *subfamiliaris* Alexander, together with the species described herewith as *L.* (*L.*) *unistriolata* sp. nov., differing in the almost uniformly black color, in addition to details of the venation and male hypopygium.

LIMONIA (LIBNOTES) PERRARA sp. nov. Plate 1, fig. 10.

General coloration of præscutum yellow in front, with four brown stripes behind; pleura yellow, with two black longitudinal stripes; halteres yellow; legs yellow, the femora with a broad dark brown subterminal ring; wings yellow, handsomely patterned with brown; Rs only slightly arcuated; m-cu just before midlength of cell 1st M_2.

Male.—Length, about 7.5 millimeters; wing, 8.5.

Female.—Length, about 7.5 millimeters; wing, 9.

Rostrum and palpi ocherous, the latter narrowly darkened at tips. Antennæ with the scape pale, the flagellum somewhat darker; flagellar segments short-oval to subcylindrical, crowded, gradually increasing in size outwardly, the terminal segment long; verticils relatively short and inconspicuous, not or scarcely exceeding the segments in either sex. Eyes of male large, contiguous; of female separated for a long distance only by a capillary strip of vertex; posterior portion of head gray.

Mesonotal præscutum in front chiefly yellow, more saturated anteriorly; four pale brown stripes on posterior half; scutal lobes brown, the median portion, with adjoining parts of præscutum and scutellum, whitish; caudal margin of scutellum narrowly blackened on either side; postnotal mediotergite gray, with a capillary pale median line. Pleura yellow, with two conspicuous blackish longitudinal areas, including a narrow dorsal stripe from the propleura to the abdomen, the second area including almost all of the sternopleurite. Halteres pale yellow. Legs with the coxæ and trochanters pale yellow; femora yellow, with a broad dark brown subterminal ring, the apical yellow

portion very narrow; tibiæ yellow; basal segments of tarsi yellow, the terminal three and distal end of the second blackened; claws with a conspicuous spine at near one-third the length, with additional smaller spines nearer the base. Wings (Plate 1, fig. 10) creamy yellow, with a handsome brown pattern, including four areas in cell Sc, the first two not encroaching on cell C, the second sending a triangular cloud along Rs; fourth area including R_2 and tip of Sc_2; cord and outer end of cell 1st M_2 seamed with brown; a broad seam on R_{2+3} for almost the entire length; a series of five oval clouds on distal portions of veins R_3 to M_4, inclusive, placed shortly before the margin; posterior margin of wing almost to tip narrowly clouded with brown; brown clouds at ends of veins Cu_1 and 2d A, the latter extended basad for about one-half the length of the vein; axilla darkened; veins yellow, brown in the clouded areas. Venation: Sc_1 ending just before the proximal end of m, Sc_2 at its tip; free tip of Sc_2 and the spur of R_{1+2} subequal, or the latter greatly reduced so that R_2 and the free tip of Sc_2 are in approximate transverse alignment; R_2 unusually long; Rs gently curved; m nearly twice as long as the basal section of M_3, gently arcuated; m-cu just before midlength of cell 1st M_2; cell 1st A at margin very much wider than cell Cu; anal veins at base almost parallel, thence divergent.

Abdomen dark brown, the caudal margins of the tergites in the male yellow; sternites paler; in female, the abdomen is more uniformly yellow, variegated laterally with blackish areas. Ovipositor dark, the cerci weakly bidentate at tips, there being a small dorsal subterminal denticle, as in the group.

LUZON, Mountain Province, Benguet Subprovince, Pauai, altitude 8,000 feet, April 21 and 22, 1930 (*F. Rivera*); holotype, male; allotype, female.

Limonia (*Libnotes*) *perrara* is a member of a group of the subgenus that includes *L.* (*L.*) *amatrix* Alexander (Japan), *L.* (*L.*) *klossi* Alexander (Federated Malay States), *L.* (*L.*) *terræreginæ* Alexander (Queensland), and possibly other species, in which the ovipositor has the cerci distinctly toothed on dorsal margin before apex. The nearest relative of the present species appears to be *amatrix*, which differs in venational details, as the very strongly arcuated Rs, the position of m-cu at about one-fourth the length of cell 1st M_2, and other details, and in the very distinct leg pattern.

LIMONIA (DICRANOMYIA) ORTHIA sp. nov. Plate 1, fig. 11; Plate 2, fig. 29.

General coloration dark brown; rostrum and antennæ black; halteres pale; wings milky white, with a heavy dark pattern that is chiefly marginal in distribution, there being a series of four darker costal areas, with gray clouds at wing tip and at ends of anal veins; Sc_2 far from tip of Sc_1; male hypopygium with the spines of the rostral prolongation short, placed close together on the small prolongation.

Male.—Length, about 5 millimeters; wing, 5.5.

Rostrum, palpi, and antennæ black throughout. Head brownish gray; anterior vertex narrow.

Mesonotum dark brown, the scutellum somewhat paler. Pleura blackish, pruinose. Halteres pale. Legs with the coxæ brownish testaceous, the fore coxæ darker; trochanters testaceous; remainder of legs pale brown; claws with a single long basal spine. Wings (Plate 1, fig. 11) with the ground color milky white, the prearcular and costal regions more yellowish; a heavy brown pattern that is chiefly marginal in distribution, including a series of four areas along the costal margin, the first being at arculus, the second at Sc_2, the third at end of Sc_1 and origin of Rs, the last stigmal; wing tip in outer end of cell R_3 clouded with gray; large gray clouds at ends of anal veins; cord and outer end of cell 1st M_2 seamed with gray; veins pale, darker in the clouded areas, yellow in the brightened costal portions. Venation: Sc_1 ending opposite origin of Rs, Sc_2 far from its tip, at near midlength of vein R; m-cu close to fork of M; cell 2d A moderately wide.

Abdomen dark, the incisures paler; male hypopygium with the basistyles dark, the large ventral dististyles paler. Male hypopygium (Plate 2, fig. 29) with the basistyles, *b*, small, the ventromesal lobe large. Dorsal dististyle a very strongly curved pale sickle, the extreme tip upcurved. Ventral dististyle, *vd*, a large fleshy lobe, the rostral prolongation small, the two spines straight, subequal in length and size, about as long as the prolongation itself. Gonapophyses, *g*, with the mesal-apical lobe gently curved to the acute tip.

LUZON, Mountain Province, Benguet Subprovince, Pauai, altitude 8,000 feet, April 21, 1930 (*F. Rivera*); holotype, male.

Limonia (*Dicranomyia*) *orthia* is allied to the larger Japanese species, *L.* (*D.*) *mesosternata* (Alexander) and *L.* (*D.*) *mesosternatoides* (Alexander), differing very conspicuously in the structure of the male hypopygium.

LIMONIA (DICRANOMYIA) NEOPUNCTULATA sp. nov. Plate 1, fig. 12; Plate 2, fig. 30.

Male.—Length, about 4.5 millimeters; wing, 4.8.

Generally similar and allied to *L.* (*D.*) *punctulata,* differing especially in the details of structure of the male hypopygium. The general coloration, wing pattern, and venation (Plate 1, fig. 12) are quite the same in both species.

Male hypopygium (Plate 2, fig. 30) with the dorsal dististyle, *dd,* subangularly bent beyond midlength. Ventral dististyle, *vd,* relatively small, the rostral prolongation with a single short stout spine from a raised tubercle, the spine about equal in length to the prolongation, evidently formed by the coalescence of two spines, the suture being evident. Gonapophyses, *g,* with the mesal apical lobe simply bifid.

Limonia (*D.*) *punctulata* (de Meijere) is well distinguished by the details of the hypopygium (Plate 2, fig. 31), especially the very slightly curved dorsal dististyle, the long, very slender rostral spine, *vd,* that is strongly curved at tip and without a basal tubercle, and the irregularly toothed gonapophyses, *g.*

Limonia (*D.*) *fullowayi* (Alexander) has the male hypopygium (Plate 2, fig. 32) with the dorsal dististyle, *dd,* very strongly curved to an acute point; rostral spine, *vd,* single, long, and very slender, without basal tubercle, entirely straight; gonapophyses, *g,* not evidently bifid at tips.

MINDANAO, Davao district, Calian, Lawa, May 3, 1930, at light (*C. F. Clagg*); holotype, male.

It is very evident that several species of *Limonia* center about *punctulata* in the Oriental-Eastern Palæarctic faunal regions. The three species compared above, having a single spine on the rostral prolongation of the ventral dististyle, and with the gonapophyses variously toothed at apices, seem to be well-separated by the genitalic differences as described. *Limonia* (*D.*) *subpunctulata* Alexander (Formosa) is distinct in the bispinous rostral prolongation. *Limonia* (*D.*) *fascipennis* (Brunetti), described from northern India, is possibly distinct from any of the above. It was described from a single broken female and since the name *fascipennis* has been used in *Limonia* (*Limnobia*) on two previous occasions, the name should be dropped until the species is rediscovered at or near the type locality.

HELIUS (EURHAMPHIDIA) FUSCOFEMORATUS sp. nov. Plate 1, fig. 13.

Unusually large (wing, female, over 6.5 millimeters); rostrum relatively elongate, about one-half longer than the remainder of head; mesonotum dark brown, restrictedly paler laterally; legs

black, the tips of the tibiæ narrowly snowy white, this including about the distal sixth or less of the segment.

Female.—Length, about 7 to 7.5 millimeters; wing, 6.5 to 7.

Rostrum unusually long for a member of this subgenus, about one-half longer than the remainder of head, black; palpi black. Antennæ with the basal segment obscure yellow beneath, the remainder of the organ black; flagellar segments oval, with verticils that exceed the segments. Head brownish gray.

Pronotum dark brown, restrictedly yellow behind. Mesonotum chiefly dark brown, the lateral portions of præscutum paler. Pleura brownish yellow. Halteres dusky, the base of the stem restrictedly yellow. Legs with the coxæ and trochanters yellow; femora brownish black, with no sign of brightening at genua; tibiæ black, the tips narrowly snowy white, on the posterior legs this including less than the distal sixth; tarsi white, the terminal segments blackened. Wings (Plate 1, fig. 13) with a pale brownish tinge, the oval stigma darker brown; prearcular and costal regions slightly more yellowish; a yellowish seam in cell M adjoining vein Cu; veins brown. Venation: Sc_1 ending opposite r-m, Sc_2 at its tip; basal section of M_{1+2} subequal to second section, the inner end of cell 1st M_2 being pointed; m-cu before midlength of cell 1st M_2.

Abdominal tergites dark brown, the sternites yellow, the subterminal segments more darkened. Ovipositor with the tergal valves slender, brownish black, their acutely upcurved tips pale.

LUZON, Mountain Province, Benguet Subprovince, Pauai, altitude 8,000 feet, April 26, 1930 (*F. Rivera*); holotype, female; paratype, female.

Helius (*Eurhamphidia*) *fuscofemoratus* may be confused only with *H.* (*E.*) *nigrofemoratus* (Alexander), which differs conspicuously in the small size, the short rostrum, and the increased amount of white on apices of tibiæ.

HELIUS (EURHAMPHIDIA) INDIVISUS sp. nov. Plate 1, fig. 14; Plate 2, fig. 33.

Male.—Length, about 4.6 millimeters; wing, 5.4.

Similar to *H.* (*E.*) *diacanthus* (Alexander) and *H.* (*E.*) *abnormalis* (Brunetti) in general appearance, differing especially in the structure of the male hypopygium.

Rostrum pale brown, a little longer than the remainder of head; palpi dark brown. Antennæ black. Head dark gray, the narrow anterior vertex more silvery gray.

Thoracic dorsum reddish brown, the median area of præscutum a little darker. Pleura more testaceous yellow, the dorsal re-

gion a little darker. Halteres pale, the knobs dusky. Legs with the coxæ pale; femora brown, the tips broadly and conspicuously white, tibiæ brown, the bases narrowly white, the amount about one-third that of the femoral tips; tibial tips broadly snowy white; tarsi white, the terminal segments darkened. Wings (Plate 1, fig. 14) whitish subhyaline, the stigmal region darker; veins pale brown. Venation: Sc_1 ending about opposite r-m, Sc_2 at its tip; m short to very short, cell 2d M_2 narrowed at base; cell 1st M_2 short, subquadrangular, m-cu at near midlength.

Abdominal tergites light brown, the sternites pale yellow. Male hypopygium (Plate 2, fig. 33) with the lateral spines of the tergite, 9*t*, simple, not bearing basal spinules or lobes, as in *diacanthus* and *abnormalis*. Outer dististyle, *od*, with delicate but distinct erect setæ for almost the whole length; in *diacanthus* and *abnormalis* the style is glabrous. Inner dististyle, *id*, narrow, terminating in two larger setæ, the margin at base almost smooth, not expanded and provided with conspicuous tubercles, as in *diacanthus*.

MINDANAO, Davao district, Calian, La Lun Mountains, altitude 5,800 feet, July 3, 1930 (*C. F. Clagg*); holotype, male.

ERIOPTERINI

TRENTEPOHLIA (MONGOMA) DISTALIS sp. nov. Plate 1, fig. 15.

General coloration dark brown to brownish black; antennæ black throughout; halteres dusky; legs black, the terminal tarsal segments paling to brownish yellow; wings with a dusky tinge, the costal region more blackened; R_3 not conspicuously arcuated; cell 1st M_2 small, m-cu beyond the fork of M; abdominal tergites black.

Male.—Length, about 7 millimeters; wing, 7.2.

Female.—Length, about 7 millimeters; wing, 7.2.

Rostrum and palpi dark, the tips of the labial palpi pale yellow. Antennæ black; flagellar segments long-oval to subcylindrical, with elongated verticils. Head black, the anterior vertex reduced to a linear strip.

Mesonotum dark brown to brownish black, the median region of scutum and lateral portions of scutellum somewhat paler. Pleura dark yellowish brown, the propleura and dorsopleural membrane dark brown. Halteres dusky. Legs with the fore coxæ dark brown, the remaining coxæ and all trochanters more testaceous brown; remainder of legs black, the terminal tarsal segments paling to brownish yellow; legs without specially devel-

oped armature of any kind. Wings (Plate 1, fig. 15) with a dusky tinge, cells C and Sc more blackish; the small ill-delimited stigma and an apical suffusion paler brown; veins brownish black. Venation: Sc_1 ending just beyond proximal end of R_2; Rs shorter than R_{2+3+4}; R_2 at or close to the fork of R_{3+4}; R_3 gently sinuous but not conspicuously arcuated at origin; cell 1st M_2 small, the fusion of R_{4+5} and M_{1+2} subequal to or one-half longer than the second section of M_{1+2}, the proximal end of cell R_5 lying proximad of any other beyond the cell; m-cu from two-thirds to nearly its own length beyond the fork of M, at beyond one-third the length of cell 1st M_2; apical fusion of Cu_1 and 1st A slight.

Abdominal tergites and hypopygium black; basal sternites yellow, blackened laterally, beyond the second segment passing into black. In the female, the sternites more uniformly brown, with narrow glabrous apical margins. Ovipositor with the cerci relatively long and slender.

MINDANAO, Davao district, Calian, La Lun Mountains, altitude 5,500 feet, July 2 and 3, 1930 (*C. F. Clagg*); holotype, male; allotype, female. "Among ferns and on mossy trees."—Clagg.

By my most recent key to the Philippine species of *Trentepohlia*[2] the present species runs to couplet 8, disagreeing with both included species in the position of m-cu, and in other characters. It may be noted that there is a slight typographical error in this couplet, the last symbol, M_3, of the second alternative (*riverai*) correctly being M_{1+2} to agree with the first alternative (*brevifusa*).

GONOMYIA (PROGONOMYIA) TEREBRELLA sp. nov. Plate 1, fig. 16.

General coloration of mesonotum reddish brown; antennæ black throughout; halteres dusky; wings with a strong brown suffusion; Sc long, Sc_1 ending opposite the fork of Rs; vein R_3 at margin close to R_{1+2}, cell R_2 being very narrow; ovipositor with the tergal valves long and chitinized, the sternal valves reduced to tiny blackened hairy lobes.

Female.—Length, about 5 millimeters; wing, 4.8.

Rostrum and palpi black. Antennæ black throughout, relatively elongate for this sex; flagellar segments oval, the verticils exceeding the segments. Head brown, sparsely pruinose.

Pronotum whitish. Mesonotal præscutum reddish brown, the median area blackened; scutum reddish brown, the centers of the

[2] Philip. Journ. Sci. 43 (1930) 297–298.

lobes conspicuously blackened; scutellum dark medially at base, the apex broadly testaceous; postnotal mediotergite black, sparsely pruinose. Pleura dark brown, variegated with light and dark areas, the obscure yellow including the dorsopleural membrane and areas dorsad of the mid- and hind-coxæ; the blackened areas occur as spots on the dorsal anepisternum and dorsal pteropleurite. Halteres dusky. Legs with the coxæ infuscated; trochanters obscure yellow; remainder of legs black, the femoral bases broadly obscure yellow. Wings (Plate 1, fig. 16) with a strong brown tinge, the stigmal region vaguely and diffusely darker; veins brownish black. Macrotrichia of costa and veins relatively long and conspicuous. Venation: Sc long, Sc_1 ending opposite the fork of Rs, Sc_2 some distance from its tip, Sc_1 being equal to R_{2+3+4}; R_3 and R_4 strongly divergent, R_3 at margin closely approaching R_{1+2}, cell R_3 being very narrow at margin; cell 2d M_2 deep; m-cu a short distance beyond the fork of M, in alignment with the other elements of the cord.

Abdomen black, the subterminal sternites paler; genital sheaths blackened. Tergal valves of ovipositor elongate, straight, reddish horn color; sternal valves reduced to tiny blackened hairy lobes, directed ventrad.

MINDANAO, Davao district, Calian, June 13, 1930, trap lantern set at edge of forest (*C. F. Clagg*); holotype, female.

Gonomyia (*Progonomyia*) *terebrella* is closest to *G.* (*P.*) *tenebrosa* Edwards (Siam) in the general coloration and structure of the ovipositor, differing in the details of venation, especially the unusually long Sc, which ends opposite the fork of Rs. The fly differs more widely from *G.* (*P.*) *brunnescens* Edwards (Borneo) in coloration and venation.

Genus ERIOPTERA Meigen

Subgenus TELENEURA subgen. nov.

Characters as in the typical subgenus, differing especially in the wing venation. Mesonotal præscutum with longitudinal rows of long erect setæ on interspaces. Veins and cells beyond the cord very elongate, the cord lying at or before midlength of the wing (Plate 1, fig. 17). Rs very short, subequal to or only a little longer than R_{2+3+4}; cell 1st M_2 open by atrophy of m; m-cu at fork of M; veins M_4 and Cu_1 deflected only slightly, cephalad at their tips; vein 2d A only gently sinuous.

In typical *Erioptera*, Rs is three or more times as long as R_{2+3+4}, the slightly oblique cord lying at or beyond three-fifths the length of the wing; vein 2d A very strongly sinuous, the distal third or fourth paralleling the anal margin of wing.

Type of subgenus, *Erioptera fusca* de Meijere (Oriental Region).

Other species pertaining to *Teleneura* are *Erioptera argentifrons* Edwards, *E. melanotænia* sp. nov., *E. nigribasis* Edwards, *E. parallela* Brunetti, *E. punctipennis* Brunetti, and *E. subfusca* Edwards, all Oriental. These species may be separated by means of the following key:

1. Wings variegated with dark areas, either on the membrane itself or as conspicuous darkened hair patches on the veins ..... 2.
   Wings uniform in color ..... 3.
2. Femora yellow, the tips imperceptibly darkened (British India: Himalayas) ..... *punctipennis* Brunetti.
   Femora yellow, with about the basal half blackened (Malay Peninsula and Borneo) ..... *nigribasis* Edwards.
3. General coloration brownish ocherous, without conspicuous markings (British India: Himalayas; Malay Peninsula) ..... *parallela* Brunetti.
   General coloration dark brown to black; if pale, variegated with black longitudinal markings ..... 4.
4. Halteres with at least the knobs yellow ..... 5.
   Halteres with the knobs blackened ..... 6.
5. Halteres yellow; general coloration of thorax dark brown; male hypopygium without conspicuous modified setæ at apex of basistyle; gonapophyses simple, crook-shaped (Sumatra and Borneo). *subfusca* Edwards.
   Halteres with the stem black, the knobs yellow; general coloration of thorax black; male hypopygium with a group of about five powerful setæ at apex of basistyle; gonapophyses bispinous, tonglike (Federated Malay States) ..... *argentifrons* Edwards.
6. Thorax brown, the lateral margins of præscutum pale; dorsal thoracic pleura with a narrow blackened longitudinal stripe (Luzon and Mindanao) ..... *melanotænia* sp. nov.
   General coloration of thorax uniform dark brown or black (Federated Malay States and Mindanao) ..... *fusca* de Meijere.

ERIOPTERA (TELENEURA) FUSCA de Meijere.

Erioptera fusca DE MEIJERE, Tijdsch. v. Entom. 56 (1913) 351.

La Lun Mountains, Calian, Davao district, Mindanao, altitude 5,800 feet, July 3, 1930 (*C. F. Clagg*). The specimens are almost black, instead of dark brown, but there seems to be no doubt as to the identity.

ERIOPTERA (TELENEURA) MELANOTÆNIA sp. nov. Plate 1, fig. 17; Plate 2, fig. 34.

Mesonotal præscutum light brown, margined with obscure yellow; pleura pale, with a black dorsolongitudinal stripe; knobs of halteres brownish black; wings with a brown tinge.

Male.—Length, about 2.5 millimeters; wing, 3.

Female.—Length, about 3 millimeters; wing, 3 to 3.2.

Rostrum and palpi black. Antennæ black. Head light ocherous, dark brown in center of vertex and on occiput.

Mesonotal præscutum and scutum brown to dark brown, the lateral margins paling to obscure yellow. Pleura obscure yellow, including the dorsopleural region and dorsal pleurotergite lying above, and the dorsal meron and sternopleurite lying below, a broad black dorsal stripe that extends from the propleura to the abdomen; ventral sternopleurite and meron again darkened. Halteres obscure yellow, the knobs brownish black. Legs with the fore coxæ dark, the remaining coxæ and trochanters obscure yellow; femora obscure yellow, this coloration obscured by dark setæ. Wings (Plate 1, fig. 17) with a brownish tinge, the base and costal region somewhat more yellowish brown; veins pale brown, the macrotrichia dark. Venation: As in the subgenus; vein 2d A ending opposite m-cu.

Abdomen brownish black, the hypopygium paler. Male hypopygium (Plate 2, fig. 34) with the tergal plate (9*t*, one-half figured) margined with conspicuous spines. Apex of basistyle, *b*, without specially modified setæ. Outer dististyle, *od*, pale, at apex expanded into a blackened setiferous head; inner dististyle, *id*, a pale flattened blade, the distal third more narrowed. Longest gonapophysis, *g*, more or less crook-shaped, its apex cultriform, the two together appearing somewhat lyriform; shorter gonapophysis, *g*, more foot-shaped, the surface with abundant delicate setæ, including a tuft of longer setæ at the region of the "heel."

LUZON, Laguna Province, Ube, February, 1930 (*F. Rivera*); holotype, male; allotype, female; numerous paratypes of both sexes. MINDANAO, Davao district, Calian, La Lun Mountains, altitude 5,500 feet, July 2 to 5, 1930 (*C. F. Clagg*); paratypes, 5 males and females.

ERIOPTERA (EMPEDA) LUNENSIS sp. nov. Plate 1, fig. 18; Plate 3, fig. 35.

General coloration of præscutum brown medially, the lateral portions gray; antennæ black, the first flagellar segment pale yellow; head blue-gray; halteres pale yellow; legs light brown, appearing darker by a covering of scales and setæ; Sc_1 ending opposite origin of Rs; cell R_3 very deep.

Male.—Length, about 2.5 millimeters; wing, 2.8 to 3.

Female.—Length, about 3.5 millimeters; wing, 3.3.

Rostrum and palpi black. Antennæ with the scape and flagellum black, the first flagellar segment abruptly pale yellow. Head light blue-gray.

Pronotum and anterior lateral pretergites whitish. Mesonotal præscutum dark brown medially, the sides light gray to blue-gray; posterior sclerites of mesonotum chiefly darkened, the posterior margin of scutellum more brightened, the postnotal mediotergite light gray pruinose. Pleura dark, sparsely pruinose, the dorsopleural membrane restrictedly pale. Halteres pale yellow. Legs with the coxæ reddish brown, the fore coxæ darker; trochanters reddish brown; remainder of legs light brown, the terminal tarsal segments passing into black; legs with flattened scales, in addition to the usual setæ. Wings (Plate 1, fig. 18) grayish, the base and costal region more yellowish; veins brown. Costal fringe relatively long and conspicuous. Venation: Sc_1 ending opposite origin of Rs, Sc_2 faint, at tip of Sc_1; R_2 slightly oblique in position, shorter than R_{2+3+4} and about one-third R ; cell R_3 unusually deep, approaching the condition in typical *Erioptera,* vein R_3 subequal to or only a little shorter than Rs; cell M_2 open; m-cu at or just before the fork of M.

Abdominal tergites brown, the sternites paler; hypopygium obscure yellow. Male hypopygium (Plate 3, fig. 36) with the outer dististyle, *od,* profoundly bifid, entirely glabrous, both arms flattened and obtuse at tips. Inner dististyle, *id,* a pale flattened blade, the distal half with microscopic sensory setæ.

MINDANAO, Davao district, Calian, La Lun Mountains, altitude 5,500 to 5,800 feet, July 3 and 4, 1930 (*C. F. Clagg*); holotype, male; allotype, female; paratypes, 12 of both sexes. "Swept from among ferns and undergrowth on margins of small brook; others at trap lantern hung among ferns in dense mossy forest."—Clagg.

Erioptera (*Empeda*) *lunensis* is most closely allied to *E.* (*E.*) *gracilis* (de Meijere), differing in the coloration and in details of venation, as the shorter Sc and deeper fork of cell R_3. Both species have conspicuous flattened and striated scales on the legs, interspersed with the usual setæ.

MOLOPHILUS BANAHAOENSIS sp. nov. Plate 1, fig. 19; Plate 3, fig. 36.

Belongs to the *gracilis* group; allied to *M. kempi;* antennæ (male) elongate; general coloration of body, antennæ, halteres, and legs blackish; wings tinged with blackish; vein 2d A relatively short; male hypopygium with the dorsal lobe of basistyle expanded at apex into a glabrous spatulate head; ventral lobe of basistyle with long coarse retrorse setæ.

Male.—Length, about 2.8 millimeters; wing, 3.5; antenna, about 2.5.

Female.—Length, about 3 millimeters; wing, 3.2.

Rostrum and palpi black. Antennæ with the scapal segments obscure yellow; flagellum black; antennæ (male) nearly as long as entire body; flagellar segments fusiform, the apical necks longer and slenderer than the narrow basal portion. Head black, sparsely pruinose.

Mesonotum black, the humeral region restrictedly paler; pseudosutural foveæ black; anterior lateral pretergites restrictedly obscure yellow. Pleura black, the ventral sternopleurite and meron a little paler. Halteres blackened, the base of the stem obscure yellow. Legs with the coxæ and trochanters obscure yellow; remainder of legs blackened. Wings (Plate 1, fig. 19) with a strong blackish tinge, the veins more seamed with darker, the extreme wing tip pale; veins and macrotrichia dark brown to black. Venation: R_2 and r-m in transverse alignment; vein 2d A relatively short, ending some distance before the proximal end of m-cu.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 36) with the basistyle, *b*, produced at apex into four distinct lobes, the outermost a small glabrous spine on outer dorsal margin; immediately laterad of this, on dorsal margin a long hairy fingerlike lobe, the apex, *db*, expanded into an obtuse glabrous spatula; mesal lobe flattened, narrowed outwardly and here provided with several long coarse setæ; ventral lobe, *vb*, longer than the mesal, more or less clavate, at apex with a group of very long, coarse, retrorse setæ (only the bases of which are shown in the figure), the longest about two-fifths the entire lobe. Outer dististyle, *od*, a glabrous blackened spine, the tip acute. Inner dististyle, *id*, subequal in length, yellow, dilated on basal half, the inner margin on basal fifth with a few setæ; apex narrowed into a spine, with a few microscopic spinulæ on outer margin before apex.

LUZON, Laguna Province, Ube (*R. C. McGregor*); holotype, male, February 12, 1930; allotype, female, April 14, 1930.

Molophilus banahaoensis is closely allied to *M. kempi* Alexander (British India: Eastern Himalayas), differing especially in the structure of the male hypopygium.

MOLOPHILUS PROCERICORNIS sp. nov. Plate 1, fig. 20; Plate 3, fig. 37.

Belongs to the *gracilis* group; general coloration of mesonotum dark brown; antennæ (male) elongate; pleura reddish yellow, variegated with brown; knobs of halteres weakly infus-

cated; male hypopygium large and conspicuous, the dorsal lobe of the basistyle terminating in a flattened glabrous blade; two dististyles, one an acutely pointed black spine.

Male.—Length, about 3.5 millimeters; wing, 4; antenna, about 2.8.

Rostrum reddish brown; palpi black. Antennæ (male) elongate, if bent backward extending to beyond midlength of the body; scapal segments obscure yellow; flagellum black; flagellar segments elongate-fusiform, with long outspreading black verticils at thickest part. Head light gray, the anterior vertex paler.

Anterior lateral pretergites pale yellow. Mesonotal præscutum with the humeral and lateral portions pale yellow, the remainder of disk chiefly covered by three dark brown stripes that are confluent or nearly so; median vitta slightly divided behind; scutal lobes dark brown; scutellum pale; postnotal mediotergite reddish brown. Pleura reddish yellow, variegated with dark brown or dorsopleural membrane and anepisternum; ventral sternopleurite and meron darkened. Halteres pale, the knobs weakly infuscated. Legs with the coxæ and trochanters yellow; remainder of legs obscure yellow, the vestiture chiefly dark; tarsal segments passing into brown. Wings (Plate 1, fig. 20) grayish yellow, the prearcular and costal regions brighter yellow; veins brownish yellow, the macrotrichia a little darker. Venation: R_2 lying distad of the level of r-m; vein 2d A relatively short, ending before the caudal end of m-cu.

Abdominal tergites brownish black, the sternites paler, the large hypopygium obscure yellow, with blackened dististyles. Male hypopygium (Plate 3, fig. 37) with the basistyles, *b*, relatively short and stout; dorsal lobe, *db*, long and relatively slender, setiferous for almost the entire length, the apex a short, sinuous, glabrous blade; ventral lobe, *vb*, short and broad, with abundant long retrorse setæ; an additional ventral lobe (not figured), small and very slender, pale, fleshy, with from six to eight setæ at and near apex, the total length being somewhat less than the main ventral lobe. Two dististyles, the outer, *od*, blackened, from a dilated flask-shaped base, the remainder a sinuous black spine. Inner dististyle, *id*, a little longer, the basal two-thirds or slightly more pale yellow, the gently curved apex blackened. Ædeagus elongate, with a conspicuous lateral flange.

MINDANAO, Davao district, Calian, La Lun Mountains, altitude 5,500 to 5,800 feet, July 2 to 4, 1930 (*C. F. Clagg*); holotype, male; paratypes, 5 males.

Molophilus procericornis is quite distinct from other members of the *gracilis* group, the chief characters being antennal and hypopygial. Females in the same collection do not seem to be conspecific and are not further discussed.

MOLOPHILUS MENDICUS sp. nov. Plate 3, fig. 38.

Belongs to the *gracilis* group; general coloration of mesonotum brownish gray; antennæ short in both sexes; halteres dusky; wings pale grayish, the veins pale; vein 2d A relatively short; male hypopygium with all lobes of basistyle fleshy and setiferous to their obtuse tips, the outer lobe bearing a blackened spinous point.

Male.—Length, about 2.8 millimeters; wing, 3.4.

Female.—Length, about 3.5 millimeters; wing, 3.5.

Rostrum and palpi dark brown. Antennæ short in both sexes, brown throughout, in the female somewhat paler. Head grayish brown.

Mesonotum brownish gray, the lateral margin and humeral region somewhat brighter, inclosing the relatively small reddish brown pseudosutural foveæ; scutellum obscure yellow, darkened medially; postnotal mediotergite plumbeous brown. Pleura plumbeous. Halteres dusky. Legs pale brown, the color chiefly produced by the vestiture; tips of tibiæ and outer tarsal segments darker. Wings with a pale grayish tinge, the veins very pale; macrotrichia dark brown. Venation: R_2 lying some distance before the level of r-m, R_{2+3+4} thus shortened, about two-thirds the basal section of R_5; vein 2d A short, ending before the level of the caudal end of m-cu.

Abdomen dark brown, the genitalia in both sexes more yellowish. Male hypopygium (Plate 3, fig. 38) with the three lobes of the basistyle, *b*, all fleshy, obtuse, provided with setæ to their tips; on margin of outer lobe, on inner face, a curved blackened hook; mesal lobe small and slenderer. Two dististyles, *d;* these entirely pale and generally similar in outline, one a little more expanded on basal half, the distal half slender, with small subappressed spines before apex, at tip with two or three setiferous punctures; second style a straight flattened blade, slightly constricted at near midlength, at apex with a very few weak spinous points. Phallosomic structure a pale cushion that is densely set with microscopic setulæ. Ædeagus very long and slender, the base more dilated.

MINDANAO, Davao district, Calian, La Lun Mountains, altitude 5,800 feet, July 3, 1930 (*C. F. Clagg*); holotype, male; allo-

type, female. "Among ferns and undergrowth along margins of small brook."—Clagg.

Molophilus mendicus is a small, insignificant species that is best characterized by the details of structure of the male hypopygium.

MOLOPHILUS TAWAGENSIS sp. nov. Plate 3, fig. 39.

Belongs to the *gracilis* group; general coloration of mesonotum light grayish brown; antennæ (male) short; pronotum and anterior lateral pretergites white; pleura liver brown; halteres with infuscated knobs; wings pale grayish, the costal region clear light yellow, the posterior prearcular region infumed; male hypopygium with only two lobes on the elongate basistyle, both obtuse and with setæ to their tips; a blunt setiferous lobe on mesal face of basistyle near origin; two dististyles.

Male.—Length, about 3.5 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ (male) short, the basal segments pale, the outer segments darkening to brown. Head pale gray.

Pronotum and anterior lateral pretergites white. Mesonotal præscutum light grayish brown, paling to clearer gray on sides; humeral and lateral portions pale yellow; pseudosutural foveæ relatively large, reddish brown; median region of scutum grayish; scutellum pale testaceous brown; postnotal mediotergite gray. Pleura relatively dark liver brown. Halteres obscure golden yellow, the knobs infuscated. Legs with the coxæ brownish yellow; trochanters obscure yellow; remainder of legs chiefly brown, the terminal tarsal segments more blackened. Wings pale grayish, the costal region clear light yellow; posterior prearcular region darkened; veins pale, the macrotrichia darker. Venation: R_2 faint, lying opposite the basal section of R_5; vein 2d A ending just before the caudal end of m-cu.

Abdomen brown, the hypopygium yellow. Male hypopygium (Plate 3, fig. 39) with the basistyles, *b*, relatively elongate, with a very deep incision down the face, separating the lateral and mesal lobes. Lateral lobes slender, much shorter than either dististyle, with setæ to the obtuse tip; mesal lobe flattened; on mesal face of basistyle, closer to base, a broad lobe set with coarse setæ. Outer dististyle, *vd*, more slender, terminating in a long acute spinous point, the surface at near midlength a trifle roughened. Inner dististyle, *id*, broader, with a conspicuous flange on basal half, the terminal bladelike portion with microscopic scattered setæ. Surface of phallosomic structure with delicate microscopic setulæ.

LUZON, Mountain Province, Ifugao Subprovince, Tawag, April 6, 1930 (*F. Rivera*); holotype, male.

Molophilus tawagensis belongs to the *costalis* subgroup, including many species in the fauna of eastern Asia. The details of the male hypopygium furnish the best characters for the separation of the various forms.

Genus STYRINGOMYIA Loew

Styringomyia LOEW, Dipt. Beitr. 1 (1845) 6.
Idiophlebia GRUNBERG, Zoöl. Anzeiger 26 (1903) 524–528.
Pycnocrepis ENDERLEIN, Zoöl. Jahrbucher 32 (1912) 65.
Mesomyites COCKERELL, Proc. U. S. Nat. Mus. 52 (1917) 377.

The now rather numerous Philippine species of *Styringomyia* may be separated in the male sex by means of the following key:

1. Wings with a strong blackish tinge, the basal fourth more yellowish; legs black, the femora with a narrow yellow subterminal ring. *fumipennis* Edwards.
   Wings yellow or yellowish, immaculate, or spotted and washed with darker ..... 2.
2. General coloration of mesonotum gray; legs uniformly brown; wings unmarked with darker; male hypopygium without specially enlarged setæ on apical lobe of basistyle ..... *mcgregori* Alexander.
   General coloration of mesonotum yellow, variegated with black; legs yellow, the femora and tibiæ ringed or spotted with brown; wings yellow, patterned with brown, at least with a small darkened spot at arculus; male hypopygium with the basistyle terminating in one or two enlarged spinous setæ ..... 3.
3. Wings unmarked, except for a tiny darkened spot at arculus ..... 4.
   Wings spotted or washed on disk with darker ..... 5.
4. Mesonotum pale yellow, the præscutum without distinct markings; halteres pale yellow; abdominal tergites with two small brown spots on caudal margin; male hypopygium with the phallosome including a flattened plate, its margin microscopically serrulate. *luteipennis* sp. nov.
   Mesonotum with the præscutum yellow, with two black lines before the suture; halteres dusky; abdominal tergites with the marginal spots confluent to form bands; male hypopygium not as above, the phallosome an elongate hook ..... *montina* sp. nov.
5. Male hypopygium with basistyle at apex terminating in two spinous setæ ..... 6.
   Male hypopygium with basistyle at apex terminating in a single setæ ..... 7.
6. Wings relatively long and narrow, the anterior branch of Rs subtransverse; male hypopygium with the intermediate and inner arms of dististyle small and inconspicuous ..... *armata* Edwards.
   Wings of normal shape, the anterior branch of Rs oblique, as usual in the genus; male hypopygium with the inner arm of dististyle expanded into an oval blade ..... *claggi* sp. nov.

7. Male hypopygium with the outer arm of the dististyle a long slender rod that terminates in a very long seta..... 8.
Male hypopygium with outer arm of the dististyle variously formed, not bearing an apical seta..... 10.
8. Wings with the veins and cells behind the anterior margin strongly washed with brown, the broad costal border yellow.
flavocostalis Alexander.
Wings yellow, with the usual four restricted dark clouds, located on the anterior cord, outer end of cell 1st M_2, m-cu, and distal end of vein 2d A..... 9.
9. Wings with vein 2d A curved at end; male hypopygium with the ninth sternite at apex very broad, heavily blackened, clothed with delicate erect setæ, the two enlarged apical bristles widely separated.
nigrosternata sp. nov.
Wings with vein 2d A short-spurred at end; male hypopygium with the ninth sternite entirely pale, narrowed to a point outwardly, the two apical bristles thus appearing approximated to actually contiguous ..... *ceylonica* Edwards.
10. Male hypopygium with the outer arm of the dististyle a simple blackened spine, the tip acute..... *tablasensis* Alexander.
Male hypopygium with the outer arm of the dististyle a powerful structure, at apex produced mesad at a right angle into a spikelike point.
neocolona sp. nov.

STYRINGOMYIA FUMIPENNIS Edwards.

Styringomyia fumipennis EDWARDS, Notulæ Entomologicæ 6 (1926) 37.

Type locality: Mount Banahao, Luzon. One male, Mount Tabuan, Cagayan, Luzon, May, 1929 (*F. Rivera*).

STYRINGOMYIA MCGREGORI Alexander.

Styringomyia mcgregori ALEXANDER, Philip. Journ. Sci. 28 (1925) 373–374.

Type locality: Manila, October, 1924 (*R. C. McGregor*). Several additional specimens, Manila, October, 1929 and 1930, at light (*McGregor*). Mr. Edwards informs me that he has seen it from Borneo and the Andaman Islands.

STYRINGOMYIA LUTEIPENNIS sp. nov. Plate 3, fig. 40.

General coloration pale yellow, the mesonotal præscutum without distinct markings; wings pale yellow, unmarked except for a dusky spot at arculus; halteres yellow; abdominal tergites with two separate brown spots on caudal margin of each; male hypopygium with a single lateral enlarged seta on basistyle; dististyle expanded into a broadly flattened blade.

Male.—Length, about 5.5 millimeters; wing, 3.5 to 3.7.

Rostrum and palpi yellow. Antennal scape brownish yellow, especially on lower face; flagellum entirely pale yellow. Head pale yellow.

Mesonotum pale yellow, the præscutum without distinct markings; postnotal mediotergite with narrow brown lateral lines. Pleura yellow. Halteres pale yellow. Legs yellow, the femora with two restricted brown areas on outer face only; tibiæ with an incomplete brown ring before midlength, the tips infuscated; tarsi yellow, the last segment dark brown. Wings pale yellow, unmarked except for a small dusky area at arculus; veins deeper yellow but still very indistinct. Venation: Anterior branch of Rs oblique; cell 2d M_2 short-sessile to more broadly sessile, in rare cases with a very short petiole; m-cu about its own length beyond the fork of M; vein 2d A curved gently to margin.

Abdomen yellow, each tergite with two brown spots on caudal margin; hypopygium yellow. Male hypopygium (Plate 3, fig. 40) small, the ninth tergite, 9*t*, terminating in a cordate setiferous lobe, the apex narrowed but obtuse. Ninth sternite, 9*s*, broad, pale, with two widely separated spinous setæ, the intervening space very gently concave. Basistyle, *b*, with a single developed apical spinous seta, its basal lobe small; a reduced set beside the major spine. Dististyle, *d*, with the outer arm pale, terminating in the usual very long seta, at base with a group of about fifteen spines and a marginal comb of ten to twelve close-set spines; main blade of dististyle broadly flattened, with abundant long black spinous setæ; two pale arms at base of dististyle, the shorter with marginal setæ, the outermost a stout black spine; longer cephalic arm slenderer, terminating in a group of six or seven stout spines. Phallosome, *p*, with a group of spinous setæ on either side; a flattened dark plate, its apex truncate, the margins microscopically serrulate.

LUZON, Laguna Province, Mount Maquiling, January 29, 1930 (*A. C. Duyag*); holotype, male; paratypes, 8 males; above Ube, foot of Mount Banahao, February 3 to 6, 1930 (*F. Rivera*); paratypes, 2 males.

Styringomyia luteipennis much resembles *S. flava* Brunetti and *S. taiwanensis* Alexander in the yellow wings, but belongs to a different section of the genus, having but a single spinous seta at apex of basistyle of male hypopygium. The small brown spot at arculus and the structure of the male hypopygium furnish distinctive features.

STYRINGOMYIA MONTINA sp. nov. Plate 3, fig. 41.

Generally similar and closely related to *S. luteipennis* sp. nov., differing in slight details of coloration and structure of the male hypopygium. Size larger and form stouter. First scapal

segment beneath and entire second segment blackened. Mesonotal præscutum with two blackish lines before the suture. Halteres dusky. Wings somewhat deeper yellow, especially in the radial field, the veins correspondingly more distinct. Abdominal tergites with the margins on caudal margin large, confluent, to form apical bands. Male hypopygium (Plate 3, fig. 41) generally as in *luteipennis*, but the phallosome, *p*, entirely different, terminating in an elongate hook, on outer margin with numerous erect spinous setæ and true spines.

LUZON, Mountain Province, Ifugao Subprovince, Pakawan, April 7, 1930 (*F. Rivera*); holotype, male; paratypes, 2 males; Banaue, April 4, 1930 (*F. Rivera*); allotype, female.

STYRINGOMYIA ARMATA Edwards. **Plate 3, fig. 42.**

Styringomyia armata EDWARDS, Ann. & Mag. Nat. Hist. IX 13 (1924) 274; Treubia 9 (1927) 355, fig. *b*.

Type locality: Mindanao. Lawa, Calian, Davao district, Mindanao, April 28, 1930 (*C. F. Clagg*); Calian, July 14, 1930 (*C. F. Clagg*), at light of house. The latter specimen is accompanied by the following note: "This walked across table with a sort of dancing motion, raising its body up and down, at regular intervals of about one-half second."

I believe the identification to be correct, despite certain details lacking in the original description. The present fly has the wing unusually long and narrow for a member of the genus, with the anterior branch of Rs subtransverse, as shown (Plate 1, fig. 21). The male hypopygium (Plate 3, fig. 42) is again illustrated, the chief characters being the bispinous basistyle, *b*, and the great reduction in size of the intermediate and posterior branches of the dististyle, *d*.

STYRINGOMYIA CLAGGI sp. nov. Plate 1, fig. 22; Plate 3, fig. 43.

General coloration yellow, heavily variegated with black; palpi and antennal scape black, the flagellum yellow; head and thorax without flattened setæ; legs with complete rings on femora and tibiæ; male hypopygium with two apical spinous setæ on basistyle, these arising from elongate tubercles; main arm of dististyle a broadly flattened blade.

Male.—Length, about 6 to 6.3 millimeters; wing, 4.5 to 5.

Female.—Length, about 5 to 5.5 millimeters; wing, 4 to 4.5.

Rostrum and palpi brownish black. Antennæ with the scape black, the flagellum abruptly pale yellow, the outer segments a trifle more darkened. Head blackish, without flattened setæ.

Pronotum obscure yellow medially, more blackened laterally. Mesonotal præscutum with the disk obscure yellow, the margin and two intermediate vittæ before the suture more blackened; scutum with the median area and centers of the lobes obscure yellow, the latter margined with blackish; scutellum blackened, the median region restrictedly obscure yellow; postnotal mediotergite black, with a capillary yellow median vitta. Pleura obscure yellow, the dorsal sclerites darker. Halteres obscure yellow; knobs dark brown. Legs with the coxæ and trochanters pale yellow; femora yellow, with two broad complete brownish black rings, in addition to the narrowly darkened tips; the more basal yellow annulus a little wider than the inclosing dark rings; outer yellow annulus narrow; tibiæ yellow, the tips and a subequal ring on basal half black; tarsi yellow, the outer segment blackened, the narrow tips of the other segments infuscated. Wings (Plate 1, fig. 22) yellow, with ill-delimited brown washes, including the anterior cord, vein Cu and vein 2d A; veins pale brown, C, Sc, and R more yellowish. Venation: Anterior branch of Rs normally oblique; cell 2d M_2 sessile; vein 2d A curved gently to the margin.

Abdominal tergites light brown, the caudal margins darker brown, the sternites and hypopygium yellow. Male hypopygium (Plate 3, fig. 43) with the apical lobe of the ninth tergite, 9*t*, low and obtuse, densely hairy. Ninth sternite 9*s*, narrowed apically, the terminal setæ not widely separated. Basistyle, *b*, with two relatively short apical spinous setæ from long basal tubercles. Outer arm of dististyle, *d*, a long pale structure with the usual very elongate terminal seta; main arm of dististyle a broadly flattened blade, with long setoid spines that are chiefly marginal in distribution, there being a row along outer edge and a dense patch on mesal margin at near midlength.

MINDANAO, Davao district, Calian, La Lun Mountains, altitude 5,500 to 5,800 feet, July 3 and 4, 1930, by sweeping vegetation (*C. F. Clagg*); holotype, male; allotype, female; paratypes, 1 male, 1 female; Mount Apo, 7,000 to 8,000 feet, September 21, 1930 (*Clagg*); paratypes, 1 male and 1 female.

This interesting *Styringomyia* is dedicated to my friend Mr. Charles F. Clagg, who has collected very numerous new and rare Tipulidæ in the highest mountains of Colorado and Mindanao. The species is allied to *S. ensifera* Edwards, *S. armata* Edwards, and *S. acuta* Edwards, in the bispinous basistyle of the male hypopygium, differing in the unmodified setæ of the

head and thorax, and the details of the hypopygium, notably the greatly expanded inner arm of the dististyle.

STYRINGOMYIA FLAVOCOSTALIS Alexander.

Styringomyia flavocostalis ALEXANDER, Philip. Journ. Sci. 27 (1925) 76–77.

Type locality: Mount Maquiling, Luzon. Additional specimens, Ube, Laguna Province, Luzon, altitude 300 to 400 meters, January 26, 1930 (*R. C. McGregor*).

STYRINGOMYIA NIGROSTERNATA sp. nov. Plate 3, fig. 44.

General coloration chiefly pale; rostrum, palpi, and antennal scape blackened; mesonotal præscutum with a broad medial darkening; pleura yellow; wings pale yellow, with the usual dark spots; male hypopygium with the basistyle unispinous, this spinous seta arising from a very long basal tubercle; ninth sternite heavily blackened at apex, clothed with delicate erect black setæ.

Male.—Length, about 6 millimeters; wing, 4.6.

Rostrum and palpi brownish black. Antennæ with the scapal segments black, the flagellar segments brownish yellow. Head brownish gray, the usual setæ stout but not flattened.

Pronotum gray medially, brownish black laterally. Mesonotal præscutum chiefly ocherous, with a sparse gray bloom, the median region on anterior half with a broad brownish black stripe; a small blackish spot on either side at the suture, this area extended across the suture and partially encircling the scutal lobes on outer side; scutellum pale, with a dark spot on either side; postnotal mediotergite chiefly dark brown. Pleura light yellow. Halteres yellow, the knobs slightly more orange. Legs with the coxæ and trochanters pale yellow; femora yellow, with two narrow, incomplete brown rings; tibiæ yellow, the tips and an incomplete ring before midlength brown; tarsi yellow, the tips of the individual segments weakly darkened. Wings pale yellow, with the usual four or five brown clouds, these being on anterior cord, union of M_2 and M_3, fork of M_{3+4}, m-cu, and the distal third of vein 2d A; veins yellow, dark brown in the infuscated areas. Venation: Anterior branch of Rs normally oblique; cell 2d M_2 short-petiolate; vein 2d A curved strongly into the margin, not angulated.

Abdominal tergites yellow, the caudal margins of the segments with two small brown triangles, these becoming larger and confluent on the outer segments; in addition to the above, a median

brown clouding on basal half of tergites, on outer segments heavier and more clearly delimited; sternites and hypopygium yellow. Male hypopygium (Plate 3, fig. 44) with the apical lobe of the tergite, 9*t*, long-triangular, the tip obtuse. Ninth sternite, 9*s*, broad, the apex extensively and conspicuously blackened, the two apical spines unusually short, arising from small elevated tubercles, the surface of the lobe with short erect black setæ. Basistyle, *b*, with a single terminal spinous seta, this unusually short, less than one-half the long basal tubercle. Dististyle, *d*, with the outer arm terminating in a long seta, without spines at base; intermediate arm produced laterad into a long acute spine at near midlength, the base of this spine and the arm beyond with a row of black spines; inner arm a curved chitinized rod, the tip obliquely acute and slightly blackened; outer margin of arm at midlength with a linear group or crest of about ten to twelve spines; mesal face of arm at base with a group of long spinous setæ.

MINDANAO, Davao district, Lawa, at trap lantern, April 24, 1930 (*C. F. Clagg*); holotype, male.

Styringomyia nigrosternata is very different from other regional species in the structure of the male hypopygium, especially the dististyle and ninth sternite.

STYRINGOMYIA CEYLONICA Edwards.

Styringomyia ceylonica EDWARDS, Ann. & Mag. Nat. Hist. VIII 8 (1911) 62–63.

Type locality: Weligama, Ceylon. The following authentic Philippine records are available: Badajoz, Tablas, August 28, 1928 (*F. Rivera and A. C. Duyag*); Lawa, Davao district, Mindanao, at light, April 24, 1930 (*C. F. Clagg*).

Bezzi [3] recorded this species from Los Baños and Mount Maquiling, but this record is almost certainly erroneous, as previously indicated by Edwards.[4]

STYRINGOMYIA TABLASENSIS Alexander.

Styringomyia tablasensis ALEXANDER, Philip. Journ. Sci. 40 (1929) 344–345.

Type locality: Badajoz, Tablas, August 27, 1928 (*F. Rivera* and *A. C. Duyag*). Other Philippine records: Lawa, Davao district, Mindanao, at light, April 24, 1930 (*C. F. Clagg*); Calian, Mindanao, July 12, 1930, at light (*C. F. Clagg*).

[3] Philip. Journ. Sci. § D 12 (1917) 115.
[4] Notulae Entomologicae 6 (1926) 34.

STYRINGOMYIA NEOCOLONA sp. nov. Plate 3, fig. 45.

Closely allied to *colona;* general coloration yellow, the præscutum with black lines behind; blackened areas on femora and tibiæ restricted in area; male hypopygium with the apical lobe of the tergite truncate; ninth sternite expanded at apex and deeply emarginate.

Male.—Length, about 6 millimeters; wing, 4.3.

Rostrum brown; palpi brownish yellow, the outer segment paling to yellow. Antennæ with the basal segment black above, the remainder of organ pale yellow. Head light brown.

Pronotum restrictedly pale medially, blackened laterally. Mesonotal præscutum obscure brownish yellow; marked with black behind, including two submedian black lines that converge in front, inclosing an oval ocherous median area before the suture; scutal lobes similarly ocherous, bordered externally by black; scutellum obscure yellow, margined caudally by black; postnotal mediotergite black. Pleura yellow. Halteres yellow. Legs with the coxæ and trochanters pale yellow; femur yellow. with two small black spots on upper surface only; tibiæ yellow, the tips blackened, with an additional restricted black cloud on upper surface before midlength; tarsi yellow, the terminal segment blackened. Wings pale yellow, with four blackish areas, as usual in the genus, these on anterior cord, m and adjoining veins, m-cu, and on the distal two-fifths of vein 2d A; veins yellow, blackened in the dark areas. Venation: Anterior branch of Rs normally oblique; m short but present, cell 2d M_2 being short-sessile; vein 2d A curved into the anal margin, the cell relatively wide.

Abdominal tergites yellow, the segments with two small brown spots on caudal margin, those of the second segment large, of segments three to five small, on the outer segments again becoming larger and confluent; sternites and hypopygium yellow. Male hypopygium (Plate 3, fig. 45) with the apical lobe of the tergite, 9*t*, elongate, gradually narrowed outwardly, the apex truncate. Ninth sternite, 9*s*, very slender, expanded outwardly, the apex deeply bilobed by a U-shaped notch, the slender lobes with two long setæ, one apical, the second placed more laterally at base. Basistyle, *b*, with the apical spinous seta a little shorter than its long basal tubercle. Dististyle, *d*, complex, the outer arm at apex produced mesad at a right angle into a long blackened spike, with a smaller curved black spine at bend of outer margin; intermediate arm smaller but of somewhat similar shape

to the outer arm; inner arm long, armed with groups of spines as illustrated.

In *colona* (Plate 3, fig. 46) the apical lobe of the tergite, 9*t*, is slightly longer, with the end gently emarginate. Ninth sternite, 9*s*, with the lateral margins straight, the apex more gently emarginate. Outer arm of dististyle, *d*, without a curved black spine at angle; inner arm of very different conformation, as shown.

MINDANAO, Davao district, Calian, July 16, 1930 (*C. F. Clagg*); holotype, male.

The distinctions between the present species and *Styringomyia colona* Edwards (Krakatau) are best shown in the structure of the male hypopygium.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *d*; dististyles; *db*, dorsal lobe of basistyle; *dd*, dorsal dististyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, 9th sternite; *t*, 9th tergite; *vb*, ventral lobe of basistyle; *vd*; ventral dististyle.]

PLATE 1

FIG. 1. *Dolichopeza* (*Mitopeza*) *rizalensis* sp. nov., wing.
2. *Dolichopeza* (*Nesopeza*) *melanosterna* sp. nov., wing.
3. *Dolichopeza* (*Nesopeza*) *tarsalis* Alexander, wing, medial field.
4. *Dolichopeza* (*Mitopeza*) *mjöbergi* Edwards, wing, medial field.
5. *Limonia* (*Limonia*) *bilobulifera* sp. nov., wing.
6. *Limonia* (*Limonia*) *melanopleura* sp. nov., wing.
7. *Limonia* (*Limonia*) *tremula* sp. nov., wing.
8. *Limonia* (*Libnotes*) *unistriolata* sp. nov., wing.
9. *Limonia* (*Libnotes*) *melancholica* sp. nov., wing.
10. *Limonia* (*Libnotes*) *perrara* sp. nov., wing.
11. *Limonia* (*Dicranomyia*) *orthia* sp. nov., wing.
12. *Limonia* (*Dicranomyia*) *neopunctulata* sp. nov., wing.
13. *Helius* (*Eurhamphidia*) *fuscofemoratus* sp. nov., wing.
14. *Helius* (*Eurhamphidia*) *indivisus* sp. nov., wing.
15. *Trentepohlia* (*Mongoma*) *distalis* sp. nov., wing.
16. *Gonomyia* (*Progonomyia*) *terebrella* sp. nov., wing.
17. *Erioptera* (*Teleneura*) *melanotænia* sp. nov., wing.
18. *Erioptera* (*Empeda*) *lunensis* sp. nov., wing.
19. *Molophilus banahaoensis* sp. nov., wing.
20. *Molophilus procericornis* sp. nov., wing.
21. *Styringomyia armata* Edwards, wing.
22. *Styringomyia claggi* sp. nov., wing.

PLATE 2

FIG. 23. *Dolichopeza* (*Mitopeza*) *rizalensis* sp. nov., male hypopygium.
24. *Dolichopeza* (*Nesopeza*) *melanosterna* sp. nov., male hypopygium.
25. *Limonia* (*Limonia*) *bilobulifera* sp. nov., male hypopygium.
26. *Limonia* (*Limonia*) *melanopleura* sp. nov., male hypopygium.
27. *Limonia* (*Libnotes*) *unistriolata* sp. nov., male hypopygium.
28. *Limonia* (*Libnotes*) *melancholica* sp. nov., male hypopygium.
29. *Limonia* (*Dicranomyia*) *orthia* sp. nov., male hypopygium.
30. *Limonia* (*Dicranomyia*) *neopunctulata* sp. nov., male hypopygium.
31. *Limonia* (*Dicranomyia*) *punctulata* de Meijere, male hypopygium.
32. *Limmonia* (*Dicranomyia*) *fullowayi* Alexander, male hypopygium.
33. *Helius* (*Eurhamphidia*) *indivisus* sp. nov., male hypopygium.
34. *Erioptera* (*Teleneura*) *melanotænia* sp. nov., male hypopygium.

PLATE 3

FIG. 35. *Erioptera* (*Empeda*) *lunensis* sp. nov., male hypopygium.
36. *Molophilus banahaoensis* sp. nov., male hypopygium.
37. *Molophilus procericornis* sp. nov., male hypopygium.
38. *Molophilus mendicus* sp. nov., male hypopygium.
39. *Molophilus tawagensis* sp. nov., male hypopygium.
40. *Styringomyia luteipennis* sp. nov., male hypopygium.
41. *Styringomyia montina* sp. nov., male hypopygium.
42. *Styringomyia armata* Edwards, male hypopygium.
43. *Styringomyia claggi* sp. nov., male hypopygium.
44. *Styringomyia nigrosternata* sp. nov., male hypopygium.
45. *Styringomyia neocolona* sp. nov., male hypopygium.
46. *Styringomyia colona* Edwards, male hypopygium.

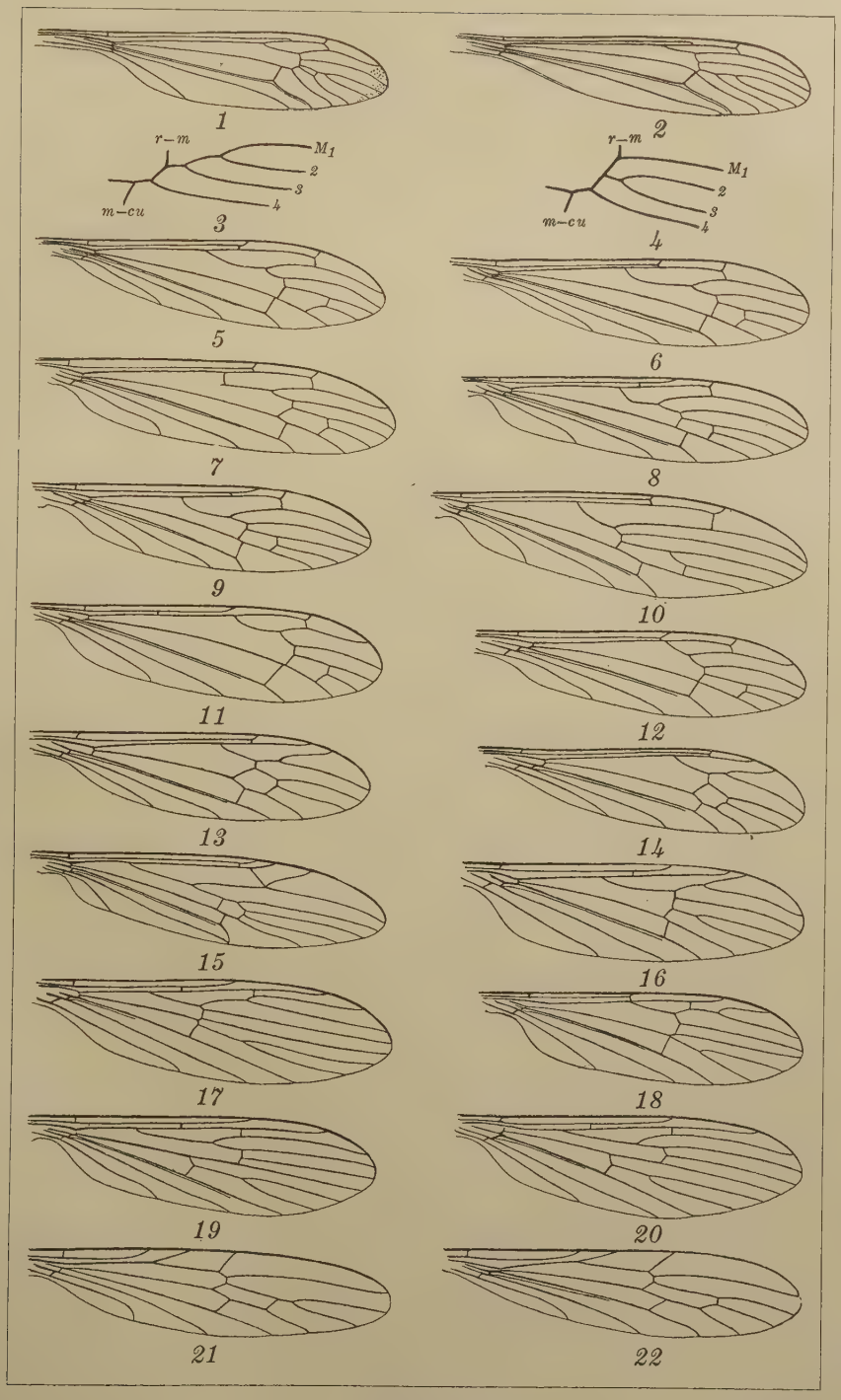
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PLATE 1.

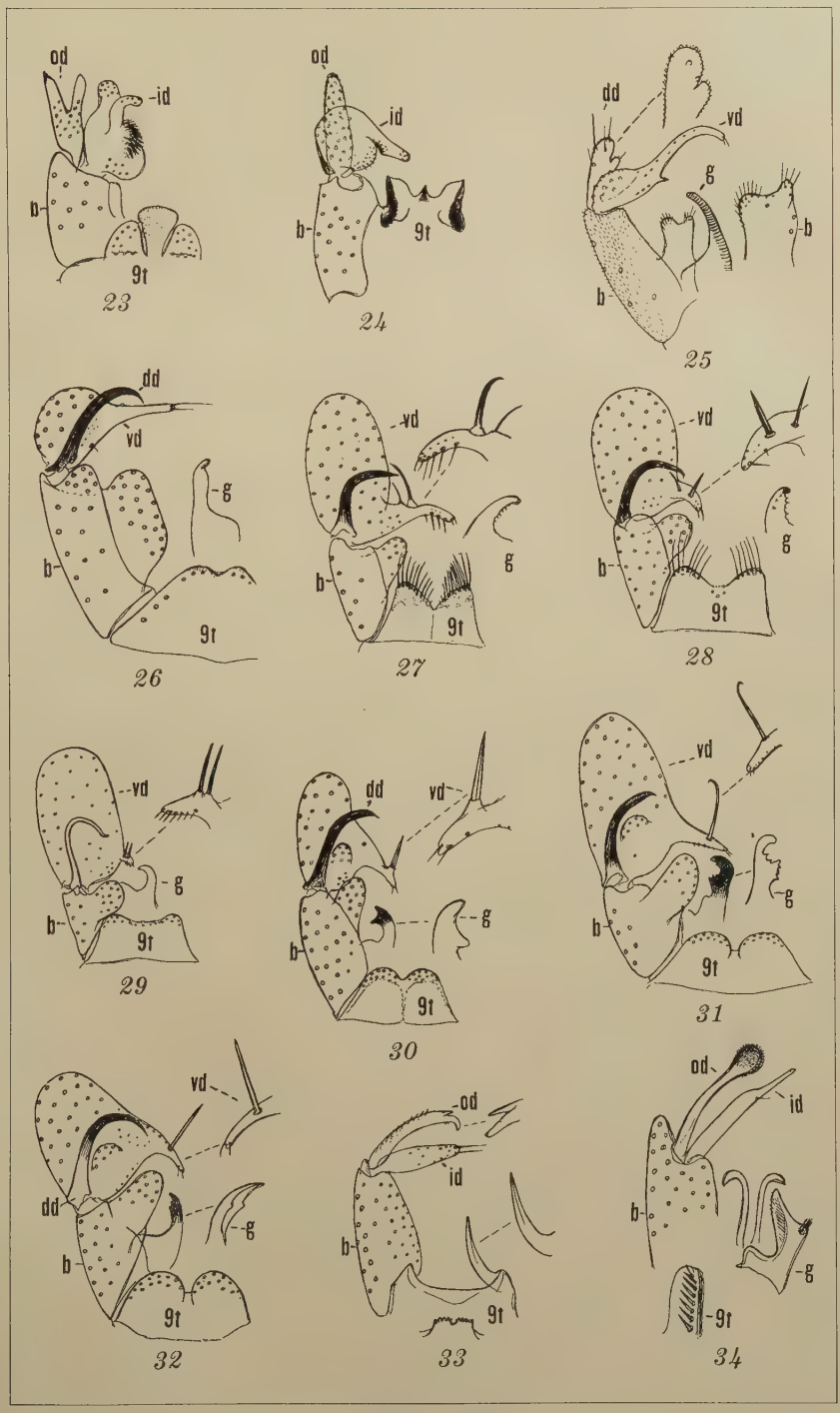
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PLATE 2.

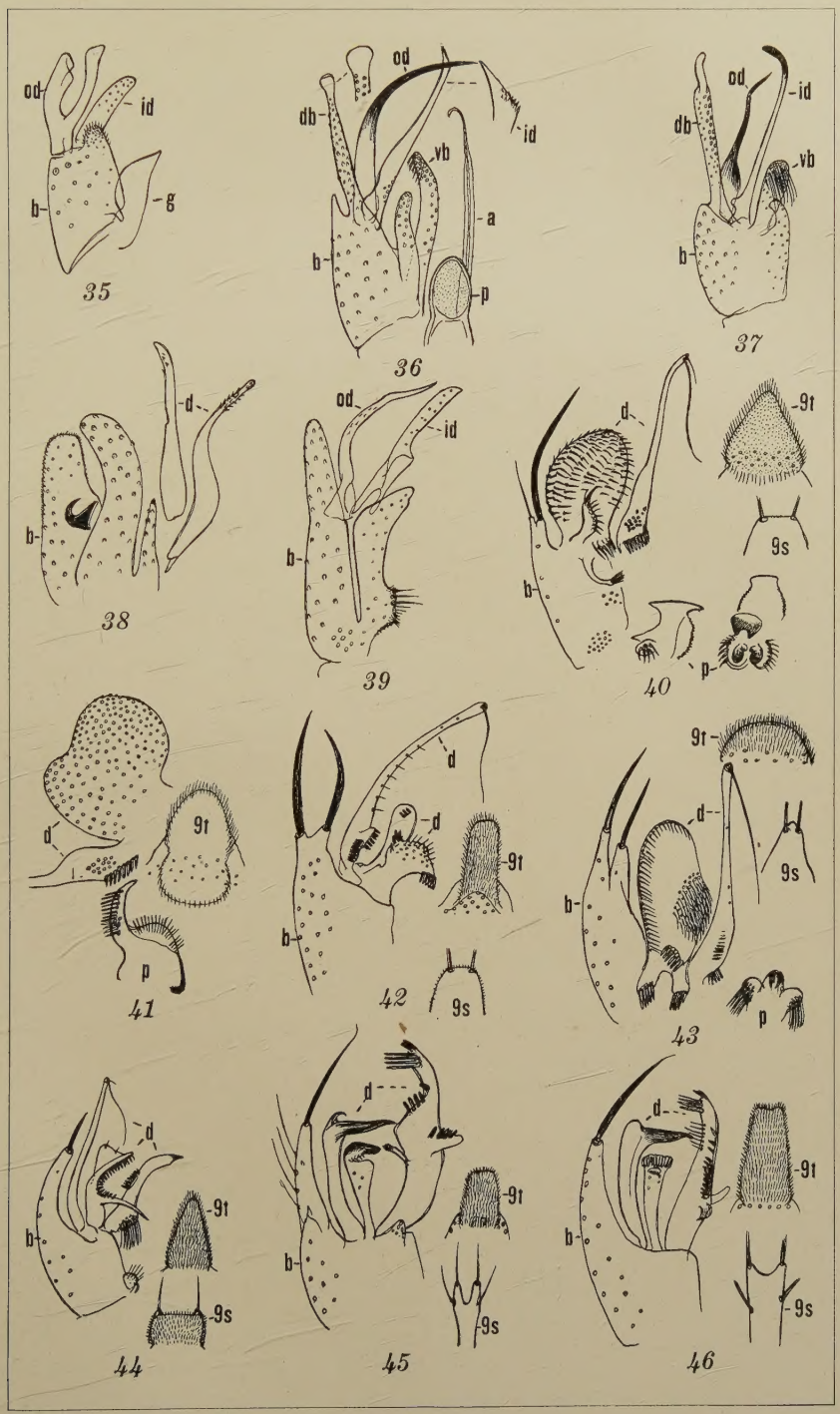
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PLATE 3.